

CANADIAN ELECTRONICS ENGINEERING

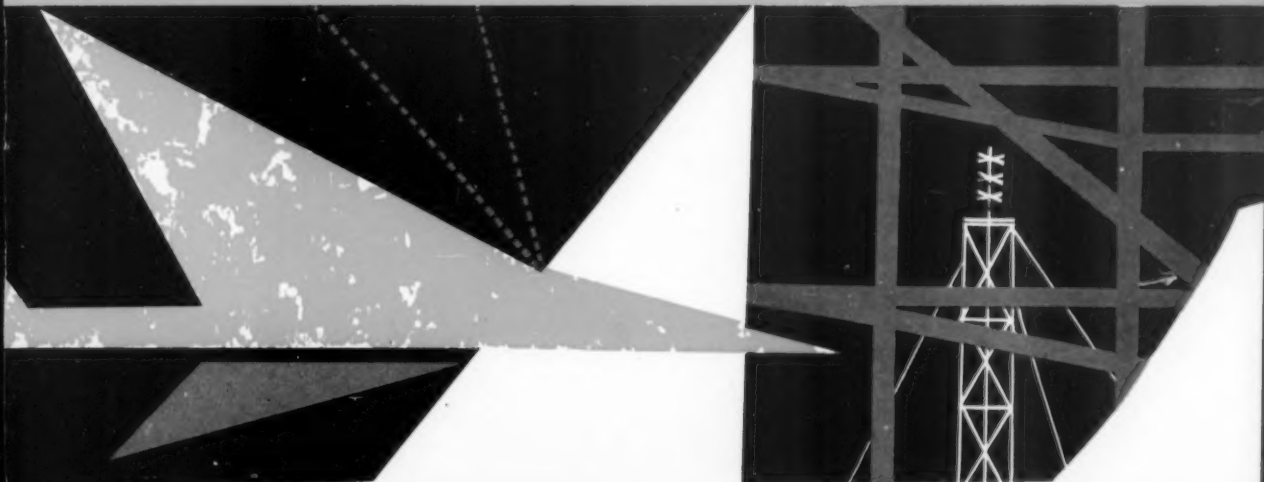
FEBRUARY 1959

A Maclean-Hunter publication

five dollars a year

APR 17 1959

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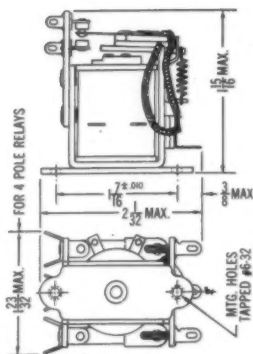
NOW AVAILABLE IN CANADA...KL... A VERSATILE, RELIABLE, LOW COST P & B RELAY for communications and automation

ECONOMY and versatility distinguish our KL series relays. Contact arrangements are available up to 4 pdt in either AC or DC versions. Sensitivity of 100 milliwatts per movable arm is available.

Stationary contacts and terminals are mounted on a phenolic front of high dielectric strength, thus adding to the utility of the relay. Conveniently located terminals and easy-to-mount base greatly simplify installation on long production runs.

KL relays may be hermetically sealed or furnished in metal dust covers.

This is one of a "family" of fine P&B relays. Others, with similar configurations but various electrical and switching capacities, are shown below. Write or call for more information or see the complete P&B catalog in Sweet's Product Design File.



KL ENGINEERING DATA

GENERAL: Breakdown Voltage: 500 volt rms, 60 cycle between all elements standard 4 pole relay; 1500 volts rms, 60 cycle on special 3 pdt relay.

Temperature Range: -45°C. to +85°C.

Pull-in: Approx. 75% of nominal dc voltage.

Approx. 78% of nominal ac voltage.

Terminals: Pierced solder lugs for two #20 AWG wires.

Enclosures: Metal can 2 3/4" high x 2 7/8" long x 2 1/2" wide with octal plug or multiple solder header.

CONTACTS: Arrangements: up to 4 pdt.

Material: 1/8" dia. gold-flashed silver. (Others available.)

Load: 5 amps @ 115 volts, 60 cycle resistive loads.

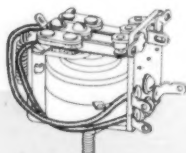
COILS: Resistance: 60,500 ohms max.

Power: 100 milliwatts per movable arm.

Duty: Continuous; coils will withstand 6 watts @ 25°C.

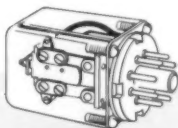
Voltages: up to 110 volts dc.
up to 230 volts ac.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



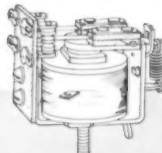
KR SERIES: SMALL, 5 AMP RELAY

Ruggedly constructed for long life and dependability. Available up to 3 pdt.



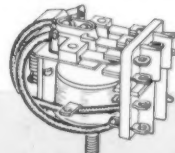
KCP SERIES: SENSITIVE 3 PDT RELAY

For plate circuit applications requiring low cost, sensitive relay. Polyethylene dust cover.



KT SERIES: ANTENNA RELAY

Insulated to minimize RF losses. Designed to switch 500 watts RF input to 300 ohm line.



KA SERIES: GENERAL PURPOSE

Compact, light-duty relay. U/L approved. Meets 1500 volts rms breakdown requirement.



POTTER & BRUMFIELD

CANADA LTD.

GUELPH, ONTARIO

Volume three, number

2

CANADIAN ELECTRONICS ENGINEERING

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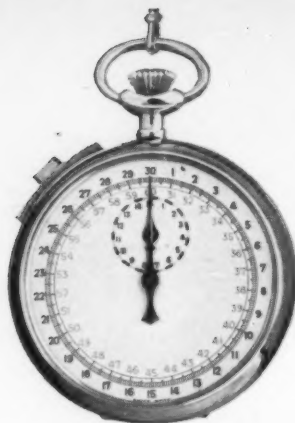
Departments

*our cover design

Communications is a vital part of the aircraft operators' world. Artist Howard Pain has used some basic elements to portray a feeling of space—with ground contact.

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TIMING ACCURACY



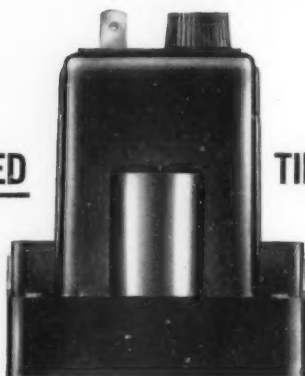
AND REPEATABILITY

AT A MOST



PRACTICAL COST:

NEW TRANSISTORIZED



TIME-DELAY RELAY

If you've been cost-stymied in your shopping for an accurate, thoroughly reliable time-delay relay, have a look at Heinemann's new Trans-O-Netic*. Remarkably low priced for its class, it offers repeatability of better than $\pm 5\%$ of the set delay over an operating range of 0.5 to 30 seconds. Reset is instantaneous; S.P.D.T. switching is extremely fast and

decisive. Temperature effects on time delay are negligible. Manufactured in knob-set or screwdriver-set models, the Trans-O-Netic Relay comes to you all wrapped up in a phenolic housing compact enough to fit neatly in the palm of your hand. Sound interesting? Then send today for Bulletin 5300; it gives the essential details and specifications.

HEINEMANN ELECTRIC COMPANY  **166 PLUM ST., TRENTON 2, N.J.**

*Trans-O-Netic is a trade name of the Heinemann Electric Company.

For further information mark No. 25 on our Readers' Service Card

S.A. 1000

CANADIAN ELECTRONICS ENGINEERING

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Indexed in Engineering Index.

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BNA



Elder



Allen



Carmichael (l) and friend

contributors and special articles in this issue:

The lead story this month, and subject
for the cover illustration, is the market
survey report by **J. Gordon Elder** (Air-
borne radio — a growing market).

Mr. Elder came here in 1953 to work
with Canadian Westinghouse Ltd. on
the Velvet Glove program. For the
past three years he has been employed
by Collins Radio Co. of Canada.

He attended Hamilton Academy, Scot-
land, until 1944 and was later a radio
mechanic in the Fleet Air Arm. After
demobilization he resumed his studies at
Glasgow University, obtaining a BSc in
electrical engineering in 1951.

At present, Mr. Elder is taking evening
classes in business administration at the
University of Toronto. One of his sub-
jects is marketing management, for which
this market survey originally was made.

When we published the two papers on
the Tandem Van de Graaff installed at
Chalk River (CEE, July 1958) we de-
cided to try to obtain a paper describing
similar machines being built in England.
Dr. W. D. Allen (U.K. accelerators ex-
ploit advantages of vertical design) has
obliged with an excellent description of
the two machines.

Dr. Allen has had an interesting series
of research assignments in what could
best be described as a combination of
electronics and physics. During the sec-
ond war he did waveguide research with
T.R.E. in England.

In 1944-45 he worked on the E.M.
separator project at Berkeley, Calif.,
then continued the same type of research
at Harwell from 1946 until 1951.

The following five years Dr. Allen
worked with the electrostatic generator
at Harwell, measuring fast fission cross
sections. In 1946 he was assigned to the
tandem generator project.

It was pure coincidence, but Robert
Burns would be pleased to see the list
of contributors this month. **Hugh Car-
michael** (Cosmic radiation and its origin)
graduated from the University of Edin-
burgh (BSc), then received his PhD at
Cambridge where he was awarded a re-

search fellowship at St. John's College.

Since coming to Canada in 1944 Dr.
Carmichael has worked on reactor con-
trol instrumentation, design of quartz
fibre instruments and cosmic ray mea-
surements. He is head of the general
physics branch at AECL, and has been
elected a Fellow of the Royal Society
of Canada.

Dr. Carmichael is fond of sailing and
has twice held the Canadian champion-
ship for the Y-flier class.

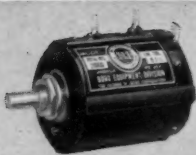


Goulding and McNaught

F. S. Goulding and R. A. McNaught
(A General Purpose Transistor Power
Supply) have worked together on tran-
sistor circuits for four years at Atomic
Energy of Canada Ltd., and have devel-
oped several transistor instruments used
in experiments at Chalk River.

R. A. McNaught switched from farmer
to electronics technician in 1949 when
he joined A.E.C.L. He has worked on
all types of nucleonic instruments and is
now a senior technician whose main
interest is in digital transistor circuits.
He is an active worker in Church and
Youth affairs.

F. S. Goulding joined A.E.C.L. in 1952
on arriving in Canada from the U. K.
He is a graduate of Birmingham Univer-
sity and has worked on radar (at T.R.E.
Malvern during the war) and all types
of nucleonic instruments (at Harwell and
Chalk River).



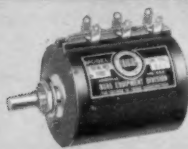
205 SERIES, 10-TURN MICROPOTS

SIZE: $1\frac{1}{4}$ " dia.; $2\frac{1}{8}$ " long;
shaft extension $\frac{7}{8}$ " or special
to order.

LINEARITY ACCURACY:
 $\pm 0.1\%$ and 0.05% (independent
or zero based).

RESISTANCES: 50 ohms to
100,000 ohms, tolerance $\pm 5\%$.

POWER DISSIPATION: 5 watts
at 40°C .



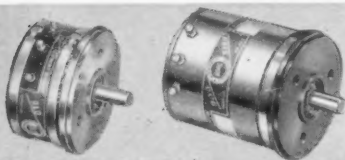
1100 SERIES, 10-TURN MICROPOTS

SIZE: $1\frac{1}{8}$ " dia.; $2\frac{1}{4}$ " long; shaft
extension $\frac{7}{8}$ " or special to order.

LINEARITY ACCURACY: 0.5%
to 0.1% (independent linearity).

RESISTANCES: 50 to 100,000 ohms,
tolerance $\pm 5\%$.

POWER DISSIPATION: 3 watts at
 40°C .



900 SERIES MICROPOTS

Borg 900 Series Micropots are available
in single-turn, 3-turn and 10-turn models.

SIZE: Single-turn — $2"$ dia.; $1\frac{1}{4}"$ long
3-Turn — $2"$ dia.; $1\frac{3}{4}"$ long
10-Turn — $2"$ dia.; $2\frac{1}{4}"$ long
Shafts — $\frac{1}{4}"$ dia.
Bushing Mount — $\frac{7}{8}"$ long
Servo Mount — $\frac{5}{8}"$ long

LINEARITY ACCURACY: Single-turn — $\pm 0.5\%$
(independent)

3-Turn — $\pm 0.1\%$ (independent, zero based, or absolute
reference).

10-Turn — 0.05% (independent, zero based, or absolute
reference).

RESISTANCES: Single-Turn — 50 to 50,000 ohms

3-Turn — 15 to 60,000 ohms

10-Turn — 50 to 300,000 ohms

TEMPERATURE LIMITS: Tested to 350°F .

STANDARD COMPONENTS

*built
by*



FIT MANY SPECIAL DESIGN NEEDS

Design flexibility of standard Borg
components often eliminates the
need for expensive, specially designed
units. Borg offers a complete line of
precision potentiometers, turn-
counting dials and fractional horse-
power motors. Many of these
standard Borg components are
currently on duty in missile
launching platforms and firing
control stations, radar and
sonar equipment, computers
and similar electronic appa-
ratus. Production of standard
Borg components assures
quick delivery. A partial
selection is shown on this
page. Write for complete
data on all Borg components.
Ask for catalog BED-A90.



990 SERIES TRIMMING MICROPOTS

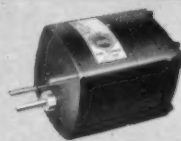
SIZE: $1\frac{1}{4}"$ x $\frac{5}{16}"$ x $1\frac{1}{4}"$

RESISTANCES: 10 to 30,000 ohms
standard. Other values on special
order.

Tolerances — $\pm 5\%$ 100 ohms and
over
 $\pm 10\%$ below 100
ohms

ADJUSTMENT: Screw driver slot
provides adjustment of complete
range in 40 turns.

TERMINALS: Printed circuit,
soldered lug, insulated wire leads.



PRECISION INSTRUMENT MOTORS

Borg-Motors offer you fractional
horsepower motors in synchro-
nous or induction models with or
without gear-trains in 2-pole or
4-pole models for your precision
equipment. Borg-Motors are totally
enclosed, using precision machined
die cast alloys for end bells and
gear train cases. Die cast rotors,
mounted on two ball bearings,
assure long life, continued accuracy.



DIRECT READING MICRODIALS

Borg Direct-Reading Microdials provide the highest accu-
racy of perception when forced-fast-reading and setting is
required because of their inline digital presentation. Borg
Direct-Reading Microdials are available in 3-digit 10-turn
models, 4-digit 100-turn models and 5-digit
1,000 turn models. Also available are Borg
Concentric Scale Microdials which indicate
the position of any multi-turn device of 10
turns or less.

WRITE FOR COMPLETE DATA ON ALL
BORG COMPONENTS — CATALOG BED A90



BORG EQUIPMENT DIVISION

Amphenol-Borg Electronics Corporation
JANESVILLE, WISCONSIN



- MICROPOTS
- MICRODIALS
- MOTORS

Canadian "Tech-Rep" — ATLAS RADIO CORPORATION, LTD., 50 Wingold Avenue, Toronto. Phone: Russell 1-6174

For further information mark No. 16 on our Readers' Service Card

News highlights...

NAE becomes new division of NRC . . .

The National Aeronautical Establishment, formerly part of the National Research Council's division of mechanical engineering, became a separate division on January 1. Facilities, all in Ottawa, include the flight research laboratories at Uplands Airport, the aerodynamics and structures laboratories on Montreal Road, and the new \$6 million supersonic wind tunnel at Uplands, scheduled for completion in 1960.

Tube cathodes now wear "sarongs" . . .

Sylvania Electric Products Inc. recently announced a new development in electron tube manufacture — cathodes with a skin-tight film coating. Sylvania claim that the new method assures more stable characteristics, less noise, and longer life compared with the conventional sprayed-on cathode coatings.

Bell cuts size of waiting list . . .

The Bell Telephone Company of Canada added more than 185,000 telephones in its Ontario-Quebec territory during 1958. The waiting list for service was reduced to 10,000 from 18,000; for individual in place of two-party lines to 11,000 from 34,000.

Big order for solar converters . . .

The increasing importance of solar energy converters as low power sources for operating equipment in space vehicles was shown by two production contracts awarded Hoffman Electronics Corp. Contracts are with U.S. Signal Corps and Space Technology Laboratories Inc., and total \$791,000.

Carson stresses need for technicians . . .

C. T. Carson, P.Eng., immediate past-president of the APEO, recently drew attention to an Association survey of the numbers of professional engineers and technicians. The survey gave a ratio of one engineer for every technician, instead of the ideal ratio of three technicians to every engineer.

Canadair may get picket plane order . . .

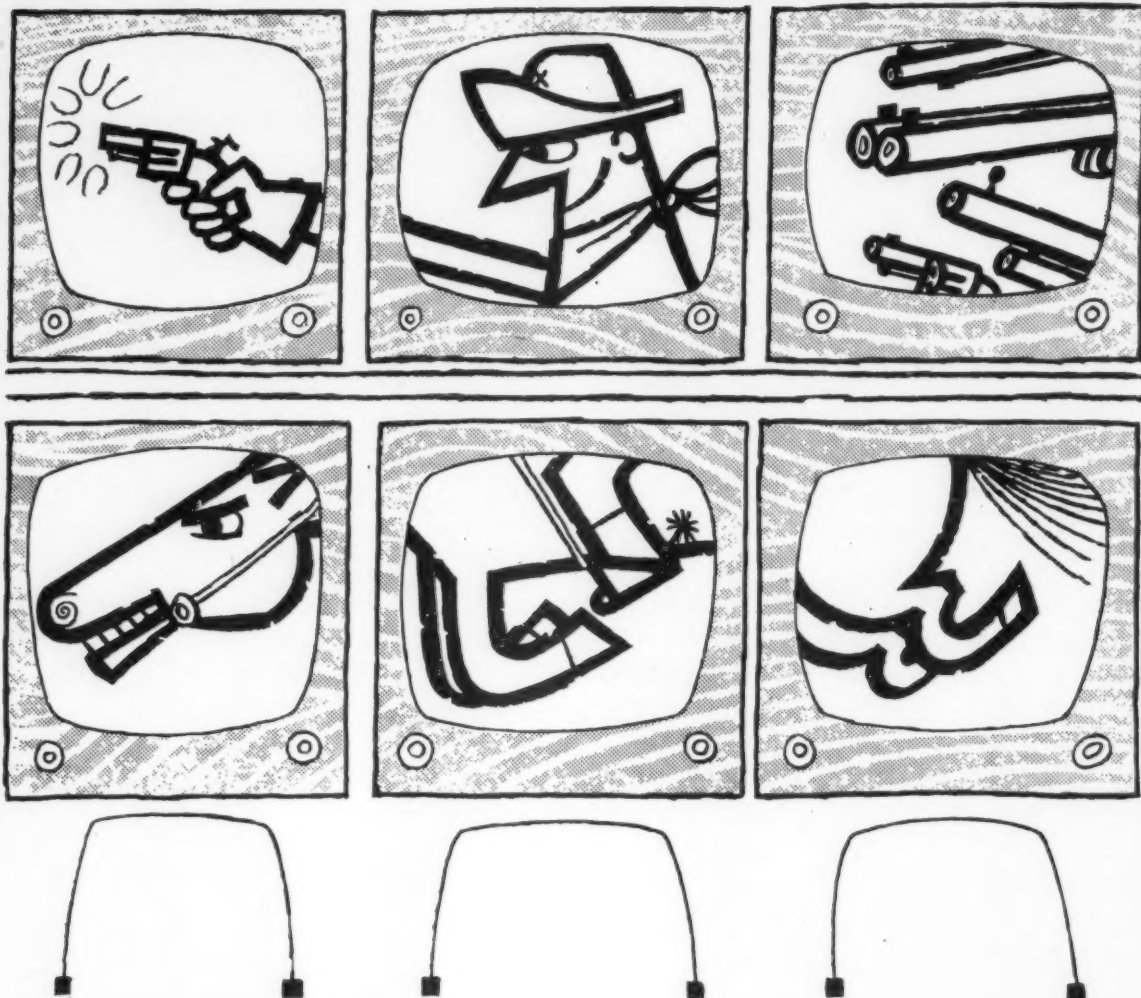
The final decision was being made last month by the USAF Air Council on the team that will produce Weapons System 214-L, a 200-plane radar picket-plane fleet. Canadair Ltd., Montreal, as part of the General Dynamics Corporation team, hoped to sell \$400 million worth of CL-44 airframes.

New panels combine two phenomena . . .

An experimental model of a panel which may some day cool a home in summer, heat it in winter and light it the year round has been demonstrated by Westinghouse Electric Corporation. This "hot-cold-light" panel combines thermoelectric refrigeration and electroluminescence in a single foot-square unit.

KLM buys twelve Dagmar systems . . .

Less than two months after Pan American World Airways' initial order for six Dagmar radar navigation systems, Canadian Marconi Company have booked an order for twelve more from KLM Royal Dutch Airlines. The present orders include the Canadian-designed and built doppler sensor but not the computer — Marconi expects to have computers on the market this fall.



More bad guys bite the dust on **Marconi** TV Picture Tubes

Once again in 1958, more new television sets were equipped with Canadian Marconi TV Picture Tubes than any other brand. Again indeed! Since the beginning of TV set production in Canada, more Marconi TV picture tubes have been used than any other brand. ■ This consistent acceptance by Canada's leading TV set manufacturers is proof of the dependable quality and performance of Marconi Picture Tubes. ■ For complete customer satisfaction specify **MARCONI RVC PICTURE TUBES**.

For further information mark No. 19 on our Readers' Service Card

Ontario engineers elect McQueen as president for 1959

A. W. F. McQueen, P.Eng., has been elected president of the 18,000-member Association of Professional Engineers of Ontario.

Associated with H. G. Acres & Co. Ltd., Niagara Falls, for the last 31 years, Mr. McQueen became its chief executive officer in 1957.

Mr. McQueen was born in Lowesoft, England in 1898 and moved to Collingwood, Ontario when he was 12 years old. In 1914 he graduated from high school. Two years later he joined the Canadian army and served in Europe. On his return to Canada he entered the University of Toronto where he received the degree of B.A.Sc. in 1923 and the professional degree of Civil Engineering in 1932.

Mr. McQueen is a director of H. G. Acres & Co. Ltd., The Fluor Corp., Ltd., of Los Angeles, and The Fluor Corp. of Canada, Ltd., Toronto.

General manager at Spaulding Fibre

The former Sales manager of Spaulding Fibre of Canada Ltd., Thomas C. Drees, has been appointed vice-president and general manager. Mr. Drees has also been elected to the board of directors.

Manager of manufacturing at General Instrument

General Instrument — F. W. Sickles of Canada Ltd., Waterloo, Ontario, announced the appointment of Fred Shuh as manager of manufacturing for the Waterloo plant, engaged in the manufacture of electronic components. Mr. Shuh has been associated with the company for three years, and prior to this time was a production manager with Canadian Westinghouse Co. Ltd.

Sales manager for McCurdy Radio

A sales engineer with several years' experience has been appointed sales manager of McCurdy Radio Industries Co. Ltd.

Roy A. Dunlop, a graduate from the University of Manitoba with the degree of B.Sc., has worked with the Department of Transport, Radio Division, and with commercial firms selling components for specialized radio equipment.

Mr. Dunlop's appointment was recently announced by Mr. George McCurdy.

Company enters the electronics field

Canadian Pratt & Whitney Aircraft Co., Ltd., has appointed James E. Smith as chief, Norden Products Sales. This appointment signals the Canadian firm's entry into the field of electronics and data processing as the Canadian representative of the new Norden Division of United Aircraft Corp.

Mr. Smith is a graduate of the University of British Columbia and has served with National Research Council, the RCAF and Computing Devices of Canada Ltd.

New product manager at Lake

Lake Engineering Co. Ltd., Scarborough, Ont., has appointed Raymond J. A. Turner as product manager with responsibility for component application engineering liaison with commercial electronic and coil manufacturers.

Ray Turner served as Signals Officer with the British Army both before and during the last war in several parts of the Commonwealth and on the Continent. Prior to his dis-

charge in 1947 he was on the staff of the Allied Military Government in West Germany with responsibility for rebuilding the communications system. He then joined Philips in Eindhoven, Holland, as a commercial engineer in their radio and television receiver group.

In 1950 Mr. Turner emigrated to Canada and held engineering positions successively with Stewart Warner and Motorola leaving the latter as chief engineer to rejoin Philips in Leaside in 1954 as a commercial engineer in their radio and television receiver division.

Mr. Turner has taken an active part in the Institute of Radio Engineers as senior member, serving for the past three years on the technical program committee of the IRE Canadian convention and is currently chairman of the convention record committee and vice-chairman of the Toronto IRE section.



BATTLEFIELD STUDIO
Fromanger



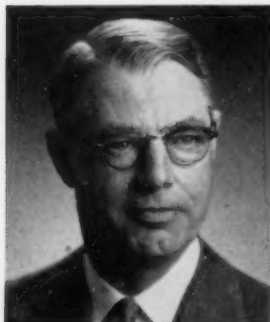
CORAL
Turner

Sales engineer for rectifier units

Syntron (Canada) Limited, Stoney Creek, Ontario, announces the appointment of Mr. Armand L. Fromanger to the position of Sales Engineer in charge of marketing for the company's complete range of Canadian made rectifier elements. Mr. Fromanger is an active member of the Institute of Radio Engineers.

His appointment is in keeping with the company's growth in the development and manufacture of dry state semi-conductors.

(Continued on page 47)



MILNE STUDIOS
McQueen



Drees



Dunlop



KINSHWALTER
Shuh

Research made a molehill out of a mountain

Collins airline quality nav/comm systems • TSO'd for all present and future IFR needs
Panel mounting in all aircraft • Digital tuning • Crystal controlled
Low power requirements • Light weight

Airline standards of quality in nav/comm system performance, reliability and safety are now available to *all* aircraft owners. Collins new panel-mounted equipments are less than nine inches long — short enough to panel mount in any single engine or larger aircraft. Receiver, transmitter, omni converter and power supply use the same components and undergo the same reliability and environment testing as the highest quality airline equipment.

51X-3 VHF RECEIVER — 190 consecutive crystal controlled channels from 108-126.9 mc. • front panel squelch and audio controls • provides VOR and localizer service when used with the 344D-1 • contains necessary control circuits and switching for glideslope channel selection • front panel edge lighting • weight 3.25 pounds.

17L-8A VHF TRANSMITTER — 90 consecutive crystal controlled channels from 118-

126.9 mc • 3 watts power output • front panel edge lighting • weight 2.5 pounds.

344D-1 OMNI CONVERTER INDICATOR — Left-Right VOR and localizer indicator • To-From indicator • VOR course selector • Reciprocal bearing reading • completely transistorized • self powered from either 13.5 or 27.5 volt line • weight 2.4 pounds.

427B-1 and 427B-2 POWER SUPPLY — Supplies power for 51X-3 and 17L-8A • contains IF amplifier, audio amplifier and modulator for receiver and transmitter • provides extra audio inputs useable for interphone • 4.5 watts of speaker audio output • transistorized power section is maintenance free, operates quietly, causes no noise in receiver • 427B-1 operates on 27.5 volts and 427B-2 operates on 13.5 volts • weight 5.0 pounds.

BASIC SYSTEM — The 51X-3 / 17L-8A / 344D-1/427B system package provides professional IFR services at a cost of

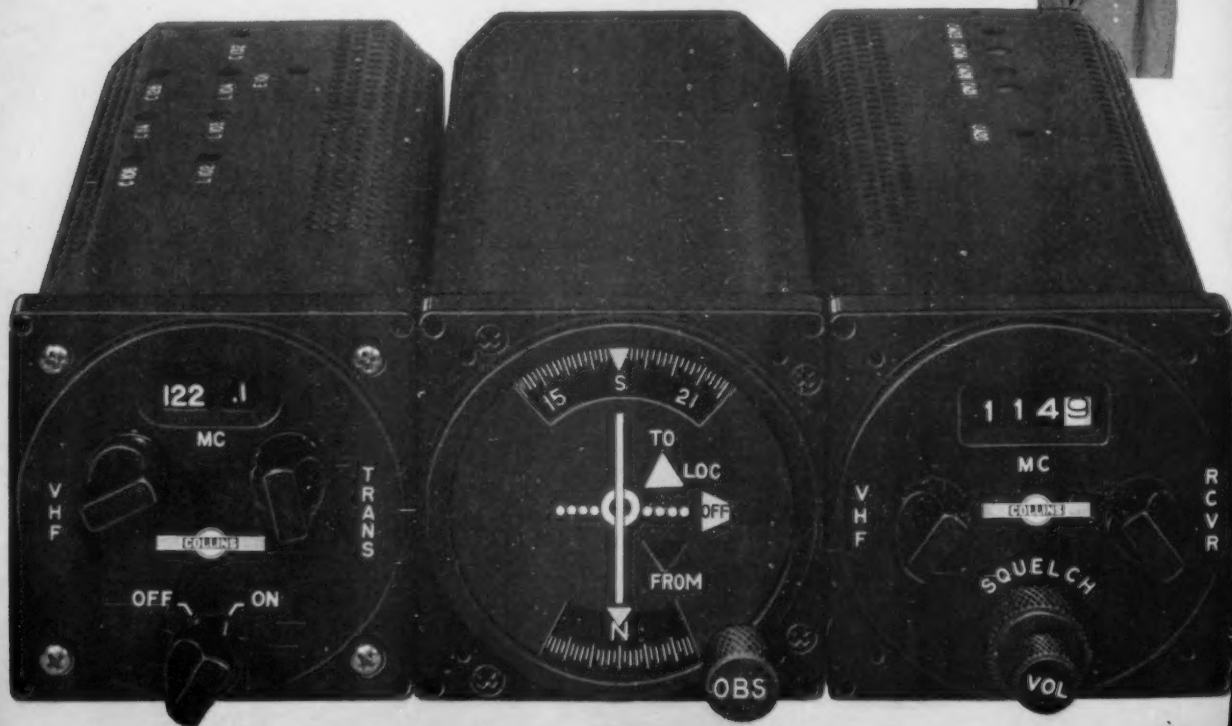
\$2370. Total weight is only 13.15 pounds. You can install the 51X-3, 17L-8A, and 427B comm System immediately for only \$1395. The 344D-1 can be added to your aircraft soon after. A marker receiver, the 51Z-2, is available at \$640.

See your nearest Collins distributor for complete information.



COLLINS RADIO COMPANY OF CANADA, LTD.
 11 Bermondsey Road, Toronto

*Ask an airline
pilot about Collins*



Ottawa research centre planned for Northern Electric

The Federal District Commission recently offered to sell 75 acres in the "Green Belt" area near Ottawa to Northern Electric Company Ltd. for a research and development centre.

Construction may start this spring at the site on Highway 17, about 10 miles west of the city. Preliminary plans envisage a campus-style layout of smaller buildings, at a cost of around \$2 million. The centre would employ about 200 persons, mainly on applied electrical and electronic research.

RCA Victor leaves patent pool

RCA Victor Company Ltd., Montreal, has terminated its association with the Canadian radio patent pool as the result of an agreement between the parent Radio Corp. of America and the U. S. Justice Department.

Canadian Radio Patents Ltd. ceased to be the licensing agent for RCA's Canadian patents at the beginning of this year.

Canadian ultrasonics firm established

A new company, TranSonic Ltd., has been established with manufacturing premises at McMaster Ave., Ajax, Ont. TranSonic is engaged in the design and manufacture of ultrasonic equipment. Products include ultrasonic homogenizing emulsifiers, and cleaners for industrial applications.

Facilities are also available for the design and engineering of custom applications including soldering, welding, brazing, non-destructive testing and control.

TV set sales down again in November

Factory sales of television receivers totaled 51,417 sets in November, compared with 60,481 in November 1957, according to EIA. Sales in the first 11 months of 1958 were 390,312, against 426,356 in the same period in 1957.

Electromechanical Products opens Montreal office

A. G. Shack, manager of Electromechanical Products, Agincourt, Ont. has announced the formation of a new branch office in Montreal to serve the Quebec area. Jean Baby, located at 11819 Michel Sarrazin St., has been appointed the Quebec district engineering and sales representative.

Sylvania elects new president

Robert E. Lewis has been elected president of Sylvania Electric Products Inc., effective Jan. 1. Previously he was a senior vice-president.

As president, Mr. Lewis succeeds Don G. Mitchell, who will continue as chairman of the board.

Shareholders of Sylvania and General Telephone Corp. will vote Feb. 11 on a proposed merger of the two companies. Under the merger plan, Mr. Mitchell would become president of the combined company, which will be known as "General Telephone & Electronics Corp." Mr. Lewis would continue to head Sylvania, which would retain its present name and operate as a separate corporate entity.



Lewis



JOHN E. MILNE
Stechly

New representative for McIntosh and Telefunken

Mike Stechly, formerly with the sales department of McCurdy Radio Industries Ltd., Toronto, has established a new company known as Allied Electronics. Offices are at 434 Church St., Mimico, Toronto 14.

Allied will sell McIntosh amplifiers and McCurdy turntables in Ontario, and are exclusive Canadian representatives for the Telefunken line of broadcast studio equipment. They will also distribute accessories such as magnetic recording tape.

Herb Davidson (left), president of Milgray Electronics, New York, and Jack Ohlrich, TI distributor sales manager, discuss 1959 Canadian marketing plans. Milgray now distributes Texas Instruments semiconductor devices in Canada; TI's office in Ottawa will still service production quantities of semiconductors.



Many U. S. and U. K. firms appoint representatives

Canadian Electronics Ltd., Edmonton, represents Telequipment Ltd., London, England.

Venner Ltd., New Malden, Surrey, England, have appointed Electrolabs, Montreal, as their exclusive Canadian representative (time switches, decade counters, frequency and time measuring equipment, etc.).

The interests of A. H. Hunt (Capacitors) Ltd., London, England, are being handled by Adams Engineering Ltd. of Montreal, Ottawa and Toronto.

Carl Hirschmann Co. of Canada Ltd., Toronto, have exclusive rights for sales and service to the entire line of MICA FIL coil winding equipment.

Marr Electric Ltd., Toronto, were recently appointed exclusive Canadian sales representatives for the entire line of Intermatic products manufactured by International Register Co., Chicago (range and interval timers, motors, and clock movements).

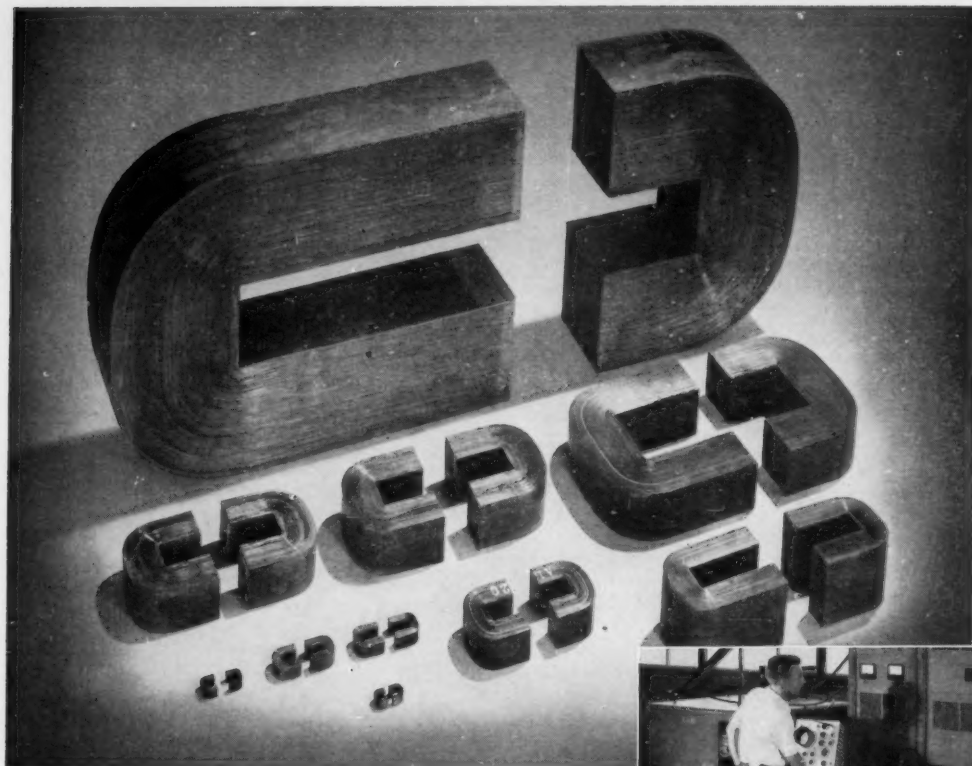
Muirhead Instruments Ltd., Stratford, Ont., have named Constellation Components Co., Toronto and Montreal, as distributors of their synchros and servomotors in Ontario, Quebec and the Maritimes.

Oryx soldering irons are now being distributed in Canada exclusively by Len Finkler & Co., Toronto.

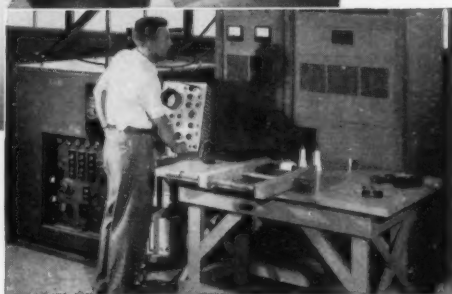
Hughes Aircraft Co. has named R-O-R Associates Ltd., Toronto and Montreal, as exclusive distributor of Hughes commercial products in Canada. The line includes semiconductors, cathode ray storage tubes, microwave tubes, test instrumentation, and the Memo-Scope oscilloscope.

Charles W. Pointon Ltd., Toronto, have been appointed Canadian sales agents for Don Bosco Electronics, manufacturers of the Mosquito transistorized signal injector.

Multitone of Canada Ltd., 24 Merton St., Toronto, is the recently formed Canadian subsidiary of Multitone Electric Ltd., London, England. The firm will market hearing aids and a personal call staff locator.



Arnold Pulse Transformer Cores are individually tested under actual pulse conditions



WSW 7372 B

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technical data on

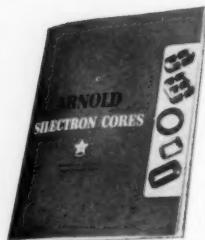
ARNOLD SILECTRON CORES

Bulletin SC-107 A

... this newly-reprinted 52-page bulletin contains design information on Arnold Tape Cores wound from Silectron (grain-oriented silicon steel). It includes data on cut C and E cores, and uncut toroids and rectangular shapes. Sizes range from a fraction of an ounce to more than a hundred pounds, in standard tape thicknesses of 1, 2, 4 and 12 mils.

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pulses per second, at a peak flux density of 10,000 gauss.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

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RANGES:

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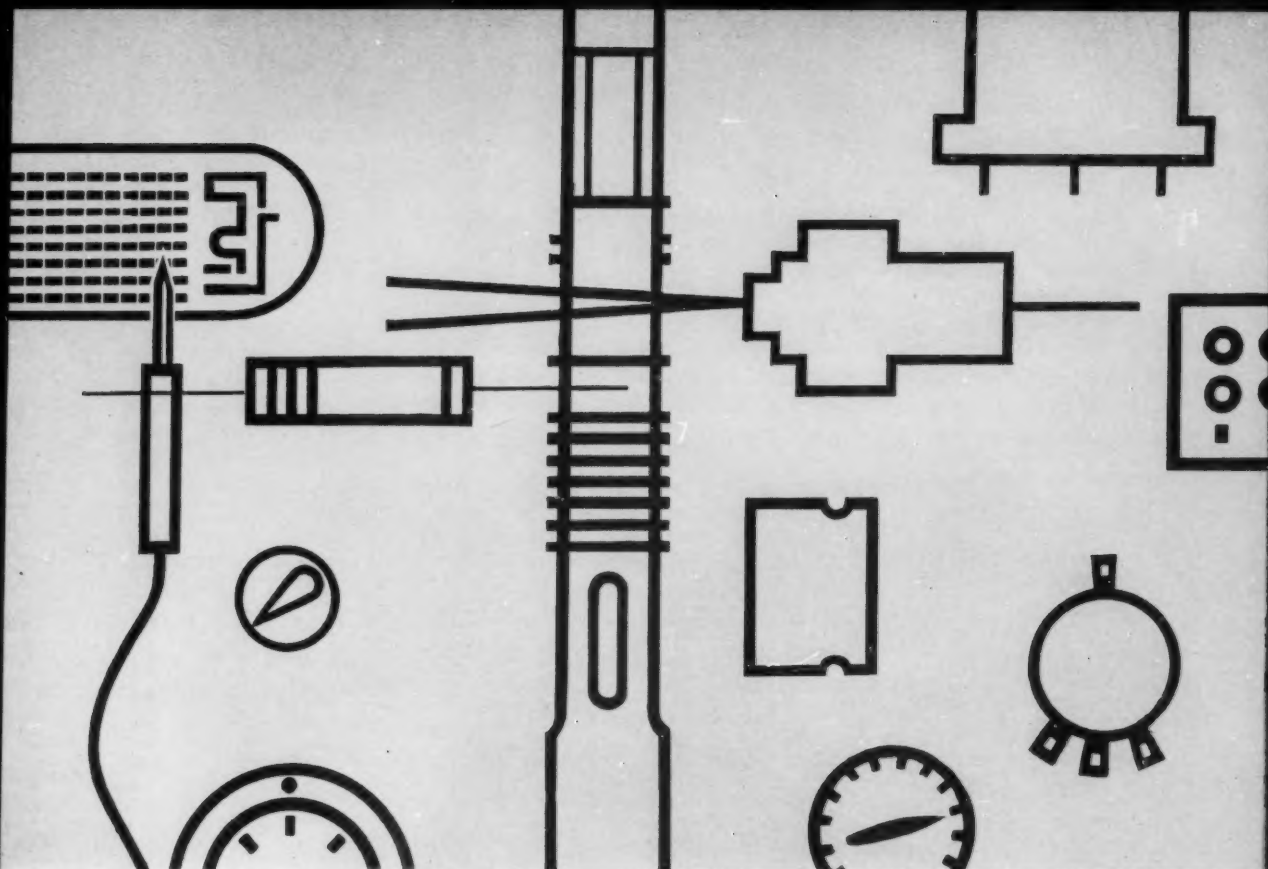
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The March issue will review a broad selection of materials, components, instruments and electronic equipment that have been introduced to the Canadian market in recent months.

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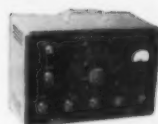
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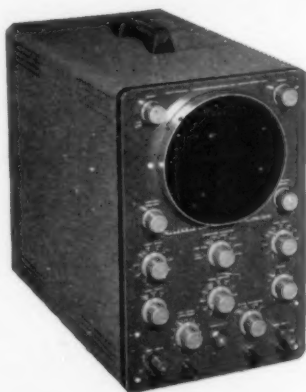


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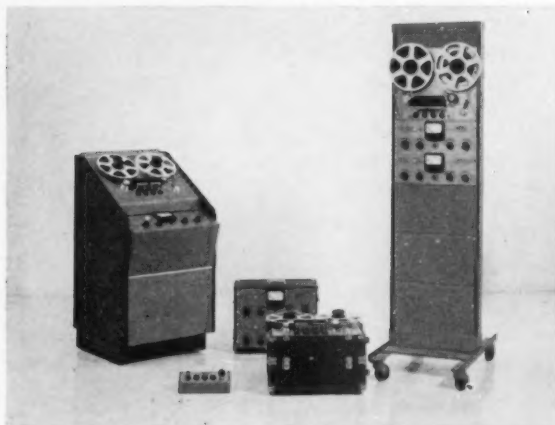
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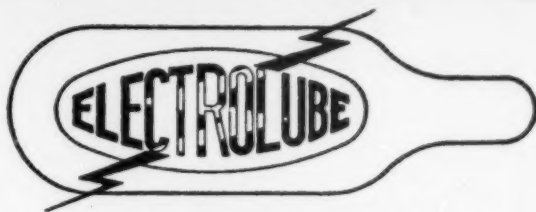
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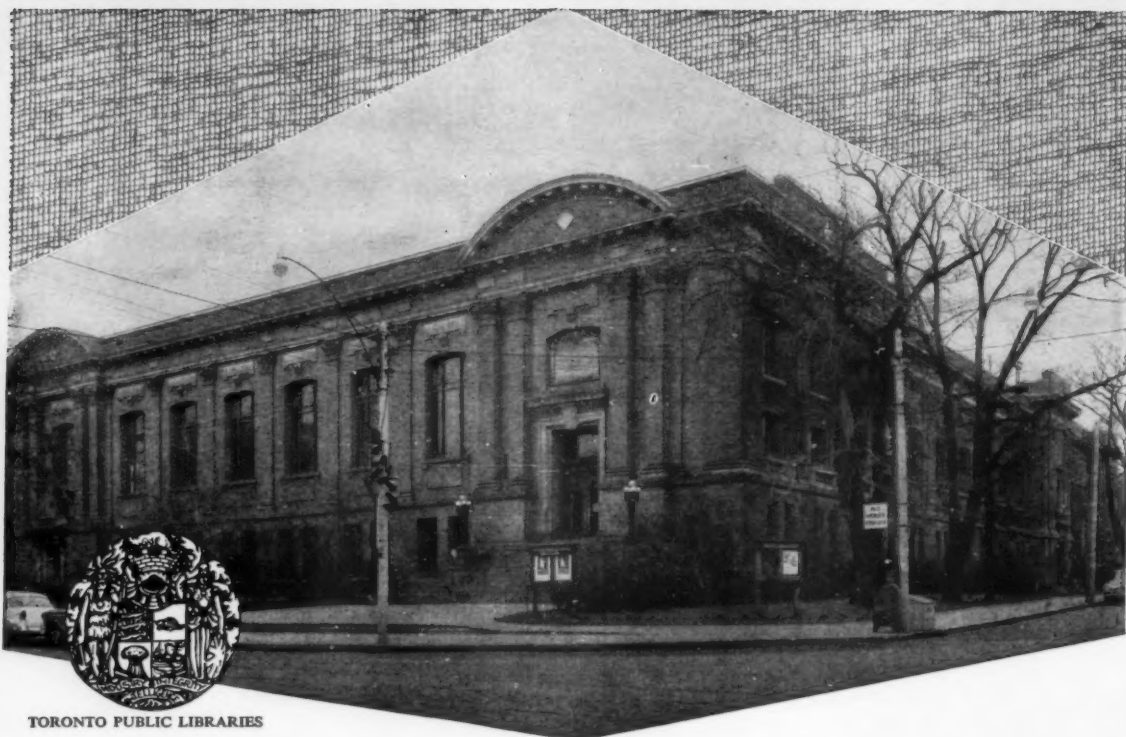
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Public Library Reports

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The McGill University Library School Documentation Seminar 1958 stated: "The pre-eminent position given to business publications has long been recognized . . . libraries have for many years devoted attention to providing the widest access to business publications".

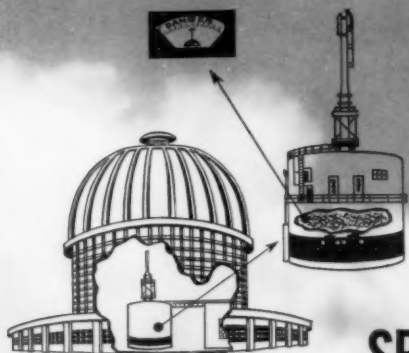
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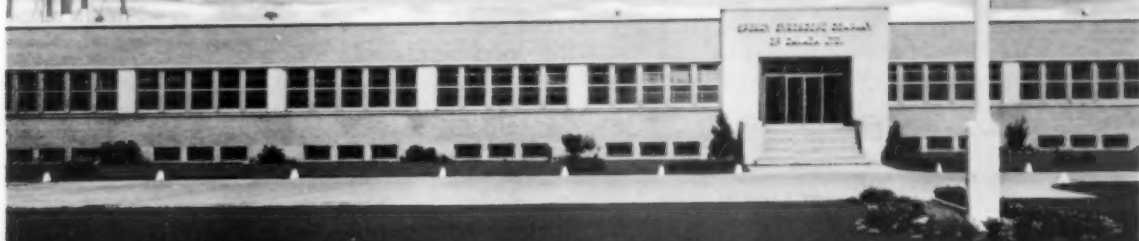
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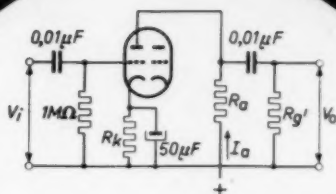
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CANADIAN ELECTRONICS ENGINEERING FEBRUARY 1959

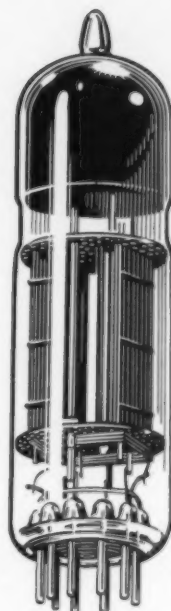
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6085

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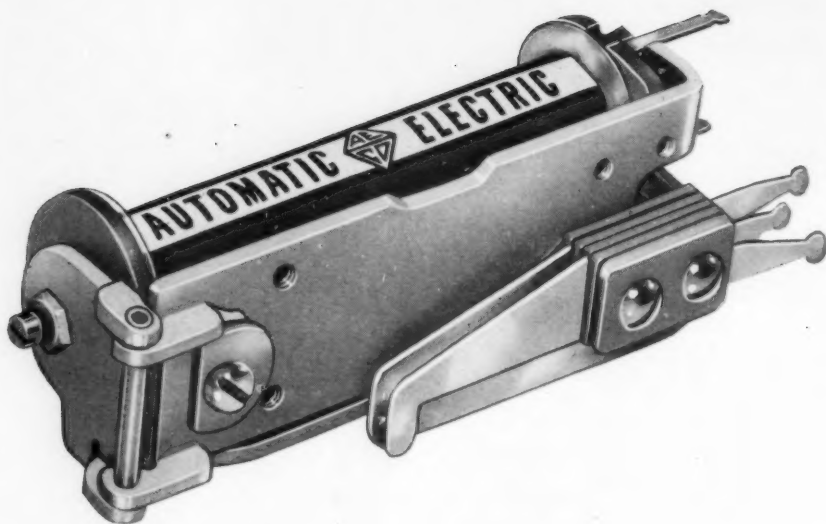
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The Canadian industry shows its paces

The efforts of the Department of Defence Production to help bring more orders into Canadian electronics plants are bearing fruit. A few Canadian companies have already secured contracts in the U. S. and some subsidiaries of U. S. firms are being fed more work by the parent companies.

Prime contractors in the U. S. have been told by the Pentagon that their government policy is to make more use of Canadian production facilities and to give our firms an equal chance to compete for contracts with U. S. firms. It is understood that U. S. contracting officers may authorize the waiving of duty on imports from Canada in cases where the prime contractor can show that savings or other advantages would be obtained.

Canadian electronics manufacturers who have been successful in obtaining orders include Canadian Westinghouse Company Ltd., Hamilton and Varian Associates of Canada Ltd., Georgetown, Ont. Westinghouse have sold tropospheric scatter communications equipment to the USAF for two separate applications. Varian have been awarded contracts for the supply of klystron tubes to several USAF prime contractors.

Opposition from U. S. manufacturers to any considerable extension of this trend may be quite strong. It would seem, however, that Canadian industry is to get some share in the production of the equipment needed for the extension of SAGE and associated programs. On the other hand, the question of participation by Canadian industry in longer range programs such as BMEWS is still very much in doubt.

No one can deny that Canada can play an important role in electronics research and development. The recent success of the Canadian Marconi Company in selling Dagmar doppler navigation systems to two of the world's major airlines is a case in point. Basic development work on this equipment was done by the Defence Research Board and Marconi carried it right through to the production of commercial systems.

Plentiful evidence of Canadian development engineering ability is available in the IRE Canadian Convention Record. In a similar way, the articles that appear month by month in this publication show that Canada does not lack the personnel and facilities essential to making its full contribution to the future of North American defence.

Steps should be taken now to ensure that full use will be made of these facilities before the current loss of personnel to U. S. employers renders them ineffective.

THE EDITOR



Collins vhf transmitter and receiver show latest design trends. Each unit mounts in 3-in.-dia hole in aircraft panel

Survey report

Airborne radio — a growing market

A recent survey shows that there is in Canada a growing market for non-military airborne radio communications equipment, of which over 80% is at present supplied by U. S. manufacturers. Present sales are about \$2 million per year and they are increasing at a rate of about 10% per year. It would seem that this market has so far been neglected or overlooked by Canadian manufacturers

J. G. ELDER, P.ENG.*

During November 1958 the author conducted a direct mail survey of Canadian aircraft operators' use of airborne radio equipment. This was an assignment related to the marketing management course of the Institute of Business Administration, University of Toronto.

The objectives of the survey were:

1. To determine details of present installations and the users' intentions regarding replacement.
2. To establish future requirements for new installations during the next few years.
3. To ascertain the opinions of the market regarding equipment performance, prices, desirable features, etc.

*Collins Radio Company of Canada Ltd., Toronto

The subject was considered to be particularly suitable for a direct mail survey, since the number of aircraft operators in Canada is quite small and few makes of radio equipment are in use. An empirical approach was used, based primarily on the author's ideas, though seasoned by those of his business associates and suggestions contained in recognized texts on consumer research.

The original intention was to include all airborne electronic equipment. It soon became obvious that this would result in an excessively long questionnaire to which few, if any, would reply. Thus only communications equipment was included, except for one general question concerning navigational aids. Even so, there were a large number of possible questions.

Several major factors in equipment specifications were deliberately omitted from the questionnaire. For example: output power and type of emission (single- or double-sideband, frequency modulation). In such cases the average user could not be expected to specify his requirements properly, since they would depend on advances in the state of the art, future Department of Transport airport facilities, and his own particular airborne operations. To specify a suitable system, a communications engineer would have to know the type of terrain to be flown over, the distances and altitudes involved, the system reliability required, pilot preferences, the funds allocated for purchase of the system, and the space, power and pay-load weight available. Lastly, selection of suitable antennas might pose difficulties, particularly if high speeds were involved, at which drag becomes pronounced.

Aeronautical mobile frequency bands

Nowadays most aircraft are equipped with hf and vhf radio. However, the obsolescent lf band is still in use, particularly by small private and flying club aircraft. The band lies between 200 and 400 kc, with control towers normally transmitting on 278 kc. They listen on 3023.5 kc, and on other hf and vhf frequencies. Radio range navigational beams also use the lf band.

The hf band extends from 1.6 mc to 30 mc. It includes about 18 frequency allocations for aeronautical mobile operations, most of which are worldwide. This band is used mainly for long range communications over one hundred miles or so. A frequency tolerance of .05% is required.

The vhf band lies between 118 and 132 mc. It provides reliable, static-free communication for airport control and other short-range operations. VHF is now installed at most Canadian airports. A frequency tolerance of at least .01% is required; the Department of Transport insists on .005%.

Specification approvals

DOT has not yet issued airborne radio equipment specifications, possibly due to the limited demand. At present it considers each manufacturer's equipment specifications and type test results, and grants an "approval certificate" to those which are acceptable. In this regard, the U. S. counterpart of DOT is CAA, the Civil Aeronautics Administration. CAA equipment type approval is usually accepted by DOT, after it has reviewed the specifications.

Because so many factors are involved, each installation must be individually tailored. A mail survey of this type is therefore appropriate for assessing general, rather than specific, operator requirements.

Extent of survey

There are about one hundred Canadian aircraft operators who are members of the Air Industries and Transport Association of Canada. Of these, about 25 operate only one aircraft. Questionnaires were sent to 60 of the remaining 75, also to four of the larger flying clubs, that are members of the Royal Flying Clubs Association.

In this country there are two hundred and five charter operators and about the same number of flying clubs. Thus, questionnaires were sent to the top 28% of the charter operators, by size. A mere 2% of the flying clubs were contacted, since when they do use radio equipment, it is usually of an obsolete lf or very simple vhf type.

There are about 4,500 aircraft licenced in Canada of which, it is estimated, around 1,000 are not equipped with radio. Most of the latter are in the under-2,000-pounds-weight category. This category accounts for about half the total, just over 2,000 aircraft. During the 1950s the annual increase in aircraft registrations has been about 10%. This rate of increase is rising.

There are 470 licenced civil airports, including 115 operated by DOT. At present, only about fifteen of the larger DOT airports require airborne two-way radio to be carried. However, as traffic increases, this requirement will apply at more airports, to maintain safety.

Analysis of replies

Eighteen completed questionnaires were returned and another one promised. Although the two major operators were not amongst those who replied, the response was gratifying and sufficient to indicate the important trends.

The following paragraphs refer to the various points raised in the questionnaire:

Present radio equipment

55 types of installation were described, in over 30 types of aircraft, ranging in size from the Fleet 80 to the DC-4 and B-17. Cessna 180s and Beavers were frequently included.

Data was given on a total of 252 installations, including 29 in helicopters. This is about 8% of the 3,000 estimated to be in service.

The aircraft supply voltage was either 12 or 24 vdc. The larger aeroplanes, often used on international survey work, also carried a 115 vac, 400 cps supply.

The lighter aircraft most frequently used Lear or Sunair equipment, though Narco, Pye, Hamlyn, Air-o-Ear, General Electric and Dare were also used. The heavier planes made use of Collins, Bendix, Aircraft Radio Corporation, Standard Telephones and Cables, and ex-military equipment. Only 54 (about 20%) of the installations included Canadian built equipment. 46 of these were owned by the Ontario Department of Lands and Forests—they included Pye (Canada) and Dare vhf sets, and their own "home-made" hf equipment.

The earliest year of installation recorded was 1946. However, some of the ex-military equipment was probably older than this.

Thirteen of the eighteen operators were satisfied with the performance of their equipment. Two of the remainder use obsolete equipment — this would account for the dissatisfaction that they expressed. The other three criticisms are quoted later.

The intended replacement date was seldom given. A few satisfied operators wrote "not known" or "no present plans for replacement." A helicopter operator wrote "as soon as possible." Other dissatisfied operators wrote "soon" and "when a satisfactory replacement is available." It is apparent that the radio equipment often lasts at least as long as the aircraft in which it is installed.

Bands used — typical replies were 3-6 or 3-14 mc for hf and 118-127 mc for vhf, indicating either that various frequencies throughout the bands are used or simply the tuning range of the equipment. Little was learned from these answers.

Average number of channels used (hf) — varied from 2 to 40, with a mean of 5.

Maximum range used (hf) — varied from 50 to 1,200 miles, with a mean of 300 miles.

Average number of channels used (vhf) — varied from 1 to 100, with a mean of 11.

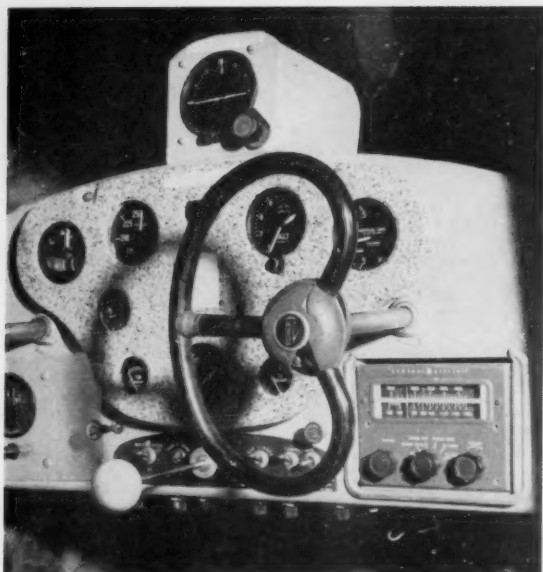
Maximum range used (vhf) — varied from 25 to 250 miles, line of sight, with a mean of 62 miles.

Estimated future requirements

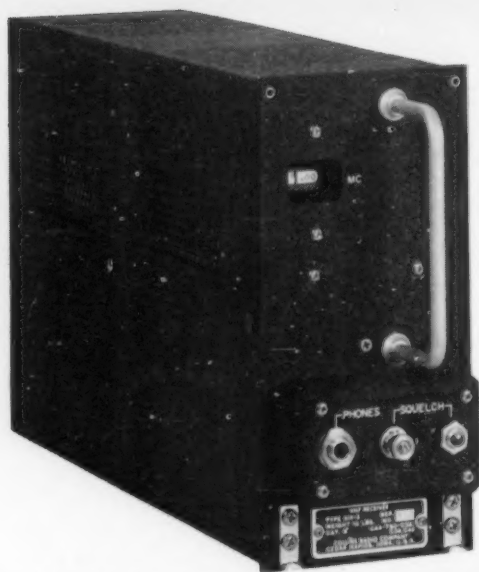
About two-thirds of the respondents estimated that a total of 75 new installations will be required within two years and 121 within five years. This figure includes both replacements and additions, and is equivalent to about 15% per year of all radio-equipped aircraft.

There were no appreciable differences between future requirements and present usage, as regards number of channels, bands and range.

The expected price for both hf and vhf averaged a little over \$2,000 for each, but ranged from \$300 to \$500 in the case of one flying club, to over \$4,000 in three other cases. The Department of Lands and Forests said that they



Typical flying club aircraft installation — General Electric Co. ASI-B 1f transceiver mounted in Cessna 140 cockpit



Collins 51X-2 vhf receiver has 880 channels with 50 kc spacing, covering 108-151.95 mc band. Weight is 10 lb

expected to pay twice as much for their executive installations as for their work-horses, the Beavers and Otters.

Eight operators would normally buy an aircraft from abroad, complete with a permanent non-Canadian radio installation. Another one would "with exceptions." Three said they would not, and six did not reply.

Preference ratings

Operators were invited to rate eight factors in order of importance, as they applied to their own operations. In order to sum the replies, eight points were allotted to "most important" and one or two to "least important." These points are listed below on a percentage basis:

Factor	Percent
High reliability	18.7
Infrequent maintenance	17.3
Light weight	16.4
Long range	16.1
Small size	11.9
Extreme temperature range	9.4
Low price	9.0
Other (ease of operation, auto tuning, fixed tuning)	1.4
	100.0

Recommended improvements

Comments included in several of the replies regarding possible improvements and desirable additional features are of interest. These are quoted below, together with an indication of the price increase the operator was willing to pay, if any.

"HF transmitter similar to Lear T30, or crystal-controlled 10-channel set with 40 to 50 watts output. Variable receiver for lf, mf and hf, plus 3 or 4 crystal-controlled channels. Transmitter should have facilities for antenna

loading by operator for peak performance while in flight or on ground. Comparing prices of aircraft radio with those of ground equipment, I fail to see justification for the high cost of the former." Expected vhf price range was \$500 to \$999.

Operator of eight light aircraft.

"Power output of the Lear T30 is too low, also the tuning of the transmitter by non-technical personnel is not satisfactory . . . Must have a tunable receiver covering the 200-400 kc band, remote-controlled transmitter, replacement without retuning or the services of technical personnel."

Operator of 23 light aircraft.

"Light executive twin-engined aircraft should have a transmitter of at least 15 watts output. Such a transmitter is scarce at present . . . Remote control of all equipment . . . Accessibility and ease of removal for servicing not been given sufficient consideration by aircraft manufacturers." Willing to accept 5% price increase.

Operator of one private aircraft.

"Crystal-controlled tuning of vhf receiver, together with lf receiver." 15% price increase.

Operator of 14 light club-type aircraft.

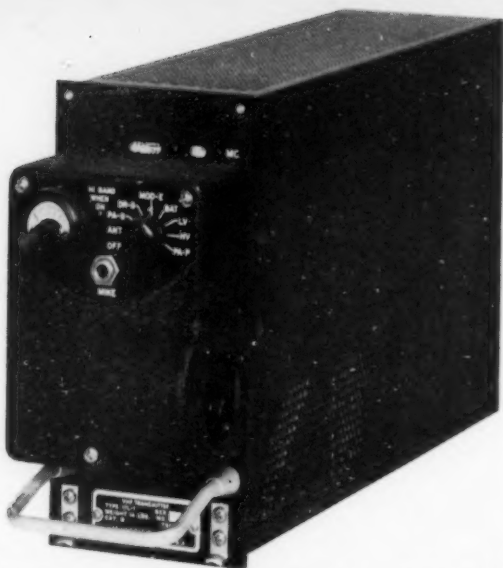
"Removal for maintenance and replacement by non-technical personnel." No price increase.

Operator of 16 light and medium aircraft.

"Improved efficiency." No price increase.

Operator of DC-3s and DC-4s.

"Performance commensurate with price and age . . . No serious thought appears to have been given to the equipment needed for general helicopter operations . . . Light weight, with particular attention to power supplies . . . Smaller over-all size . . . Automatic antenna tuning . . . Variable receiver tuning, plus crystal control." 20% price increase. *Operator of 15 transports and 25 helicopters.*



Collins 17L-7 25-watt vhf transmitter is companion unit to receiver opposite. Frequency range is 118-151.95 mc

"The Ontario Department of Lands and Forests designs and builds its own hf equipment, as it has been unable to find suitable commercial equipment for its application . . . Transistorized power supplies and modulators reduce two main sources of weight in aircraft installations."

"Elimination of rotary power supplies." 2% to 3% price increase. *Operator of nine medium transports.*

"Addition of automatic loading device on hf equipment . . . now using Sunair 5SRTR." 10% price increase. *Operator of 27 Bell and Sikorsky helicopters.*

Conclusions and recommendations

There is a small but not insignificant potential market for Canadian made, non-military airborne radio equipment. At present it is dominated by U. S. manufacturers, who sell or lease on the basis of rapid delivery, lower prices and efficient after-sales service, features that are not always obtainable from Canadian manufacturers. It is hoped that as the market continues to grow, our own manufacturers will share in it to a greater extent.

Assuming that aircraft registrations continue to rise at the rate of 10% per year, and that 75% of new registrations are to be radio-equipped, these alone would require from 300 to 400 radio systems per year. Replacements might require, say, another 150 systems per year. This amounts to about 500 in all, which compares with the figure of 420 obtained from the survey (75/2 x 3,000/252).

Let us further assume that each system includes both hf and vhf, priced at \$2,000 each. Annual sales would then amount to \$2 million (exclusive of navigational aids), about 0.4% of the electronics industry's total sales. At present, perhaps a dozen Canadian, U. S. and U. K. manufacturers compete in this market, and it is only one phase of operations for most of them.

Only 20% of the respondents' equipment was Canadian built. Much of this was used by a provincial government department, most of which buy domestically whenever

Canadian airborne radio equipment manufacturers and suppliers

The following companies are the Canadian sources of airborne transmitters, receivers and transceivers. Some stock a range of standard airborne radio equipment; others will manufacture to order.

Allied Electronics Ltd., Calgary
 Anthony Foster & Sons Ltd., Toronto
 Aviation Electric Ltd., Montreal
 Aviation Electric Pacific Ltd., Vancouver
 Avionics Ltd., Niagara-on-the-Lake, Ont.
 Aviquest of Canada Ltd., Montreal
 Avtec Systems Engineering Ltd., Winnipeg
 Canadian Aviation Electronics Ltd., Montreal
 Canadian General Electric Co. Ltd., Toronto
 Canadian Marconi Company, Montreal
 Canadian Motorola Electronics Ltd., Toronto
 Canadian Westinghouse Co. Ltd., Hamilton
 Collins Radio Co. of Canada Ltd., Toronto
 Computing Devices of Canada Ltd., Ottawa
 EMI-Cossor Electronics Ltd., Halifax
 Electromechanical Products, Agincourt, Ont.
 Electronic Materials International Ltd., Ottawa
 Ferranti-Packard Electric Ltd., Toronto
 Field Aviation Co. Ltd., Oshawa, Ont.
 Gensales Ltd., St. Catharines, Ont.
 Glenn Aviation Radio & Instruments, Gananoque, Ont.
 Leavens Bros. Ltd., Toronto
 Mel Sales Ltd., Arnprior, Ont.
 Carl Millard Ltd., Toronto
 Muirhead Instruments Ltd., Stratford, Ont.
 Northern Electric Co. Ltd., Montreal
 The Plessey Co. of Canada Ltd., Montreal
 Pulsifer Bros. Ltd., Halifax
 Pye (Canada) Ltd., Toronto
 RCA Victor Co. Ltd., Montreal
 Radio Communications Equipment & Engineering Ltd., Montreal
 Raytheon Canada Ltd., Waterloo, Ont.
 Redifon (Canada) Ltd., Montreal
 Sanderson Aircraft Ltd., Malton, Ont.
 Standard Telephones & Cables Mfg. Co. (Canada) Ltd., Montreal
 TMC (Canada) Ltd., Ottawa
 Technical Enterprises Ltd., Malton, Ont.
 Timmins Aviation Ltd., Montreal
 Trans Aircraft Co., Hamilton
 Western Airmotive Ltd., Vancouver

possible. Companies that supply the RCAF would presumably also be interested in the non-military market. However, it would probably be cheaper for them to buy from their U. S. or U. K. parent companies or affiliates, since no import tariffs are levied.

The \$2,000 price tag is prohibitive for the small operator who flies light aircraft for training, bush or other charter work. For this reason, Dare have established a rental service for their equipment, which includes maintenance as required at no extra charge. Their lowest-priced vhf system sells for only \$900, yet many operators prefer to rent. After all, they are not in the radio business, and

(Continued on page 33)

U.K. accelerators exploit advantages of vertical design

W. D. ALLEN, BSC, D. PHIL.*

The United Kingdom Atomic Energy Authority has undertaken the construction of two tandem electrostatic generators. After considering all the factors involved, they decided to use a vertical design

In the July 1958 issue of this journal, two papers described the tandem electrostatic generator being built by the High Voltage Engineering Corporation for installation at Chalk River. It may be of interest to add to these papers a brief note on the tandem generators at present under construction in England.

Although the tandem generator is a recent development, all the basic principles involved are comparatively old. As regards engineering, R. G. Herb¹ and his associates in the University of Wisconsin described in 1937 a horizontal electrostatic generator in which the central electrode was supported at both ends, the belt drive being at one end and the tube in the other.

The fundamental principle of the tandem generator, namely the injection of negative ions at the earthed end of a compound machine, the stripping of the ions of electrons at the positive centre terminal and the re-acceleration of the resulting positive ions in the second half of the machine, was described in patents taken out by W. H. Bennett² in the U. S. in 1937 and by H. Kallmann³ of Germany in 1938.

Practical possibility established

The idea was independently revived by L. W. Alvarez⁴ in 1951, who suggested that negative ions should be injected at the base of a single-ended generator, deflected through 180 degrees at the centre terminal, and stripped and re-accelerated in a second tube in the same stack. It was not, however, until negative ion sources delivering currents of 20-30 microamperes of H⁻ ions were developed by the University of Wisconsin⁵ in 1955, that the feasibility of the tandem generator as a practical possibility became firmly established.

*United Kingdom Atomic Energy Authority, Harwell.



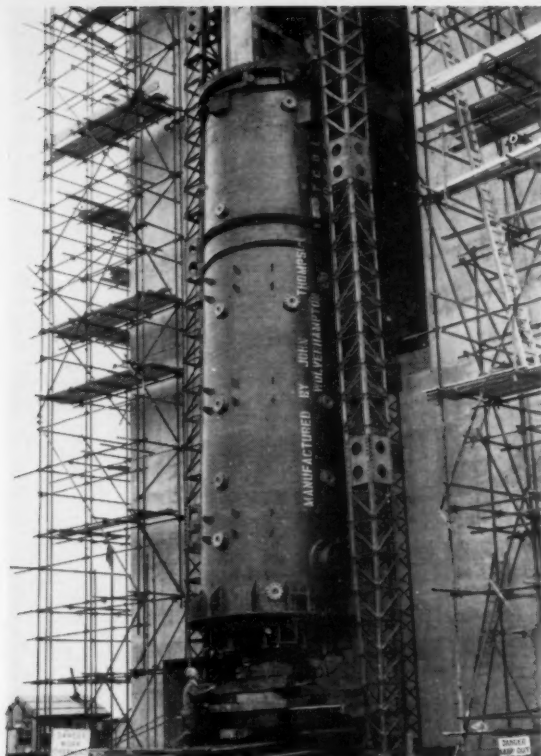
Model of the vertical tandem generator being built at Harwell by the United Kingdom Atomic Energy Authority

Physicists were perhaps a little slow to appreciate the possibilities of the new machine, which were early recognized and advocated by the High Voltage Engineering Corporation. In due course, a contract with the HVEC was placed by Chalk River for the first machine. The success of the HVEC in the preliminary tests on this machine has given satisfaction on both sides of the Atlantic, because at the time the Canadian contract was placed, the United Kingdom Atomic Energy Authority was showing increasing interest in the possibilities of the tandem generator. To a degree, this interest was direct. Thus, the availability of a proton or deuteron beam variable in energy up to 12 MeV makes possible a neutron source of any energy between 20 keV and 25 MeV. Also, our knowledge of the nuclear energy levels of the heaviest elements is at present fragmentary. With a 12 MeV deuteron beam of high resolution using the (d,p) reaction, a thorough and extensive investigation of these levels could be made. Over and above these applications, however, the tandem generator will clearly be a very flexible tool.

Any element capable of forming negative ions—a criterion which includes about half the elements of the periodic table — is capable of being accelerated. Hence, in addition to the extensive fields of study made possible by the availability of precision beams of protons and deuterons with energy variable up to 12 MeV, one can look forward to the opening up of many entirely new fields of development.

Decision to build two machines

In June, 1956, therefore, it was decided to build two machines in the UKAEA for the proton energy range 10-12 MeV, one at the Atomic Energy Research Estab-



Pressure vessel of the vertical tandem generator being installed in its tower, Aldermaston, Berkshire, England

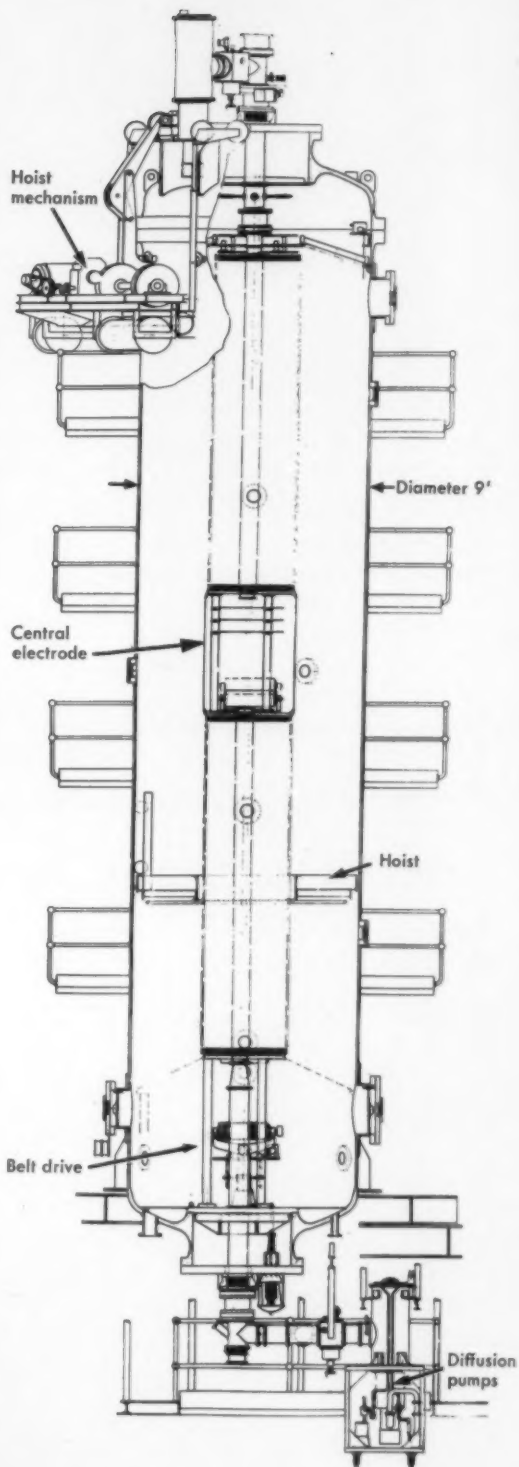
lishment at Harwell, Berkshire, the other at the Atomic Weapons Research Establishment at Aldermaston, Berkshire. The provision of ion sources, strippers and tubes for these machines is the responsibility of the UKAEA, while the provision of the engineering components has been undertaken by the Metropolitan-Vickers Electrical Company Ltd. Both machines are vertical types.

As compared with the horizontal machine, the vertical machine has advantages and disadvantages. The chief advantage of the horizontal machine, as exemplified in the Chalk River machine building, is that there is no problem in making allowance for future developments — the length of the building housing the machine can, in principle, be unlimited. One such possible development was described by Danforth at the end of his article in the July issue.

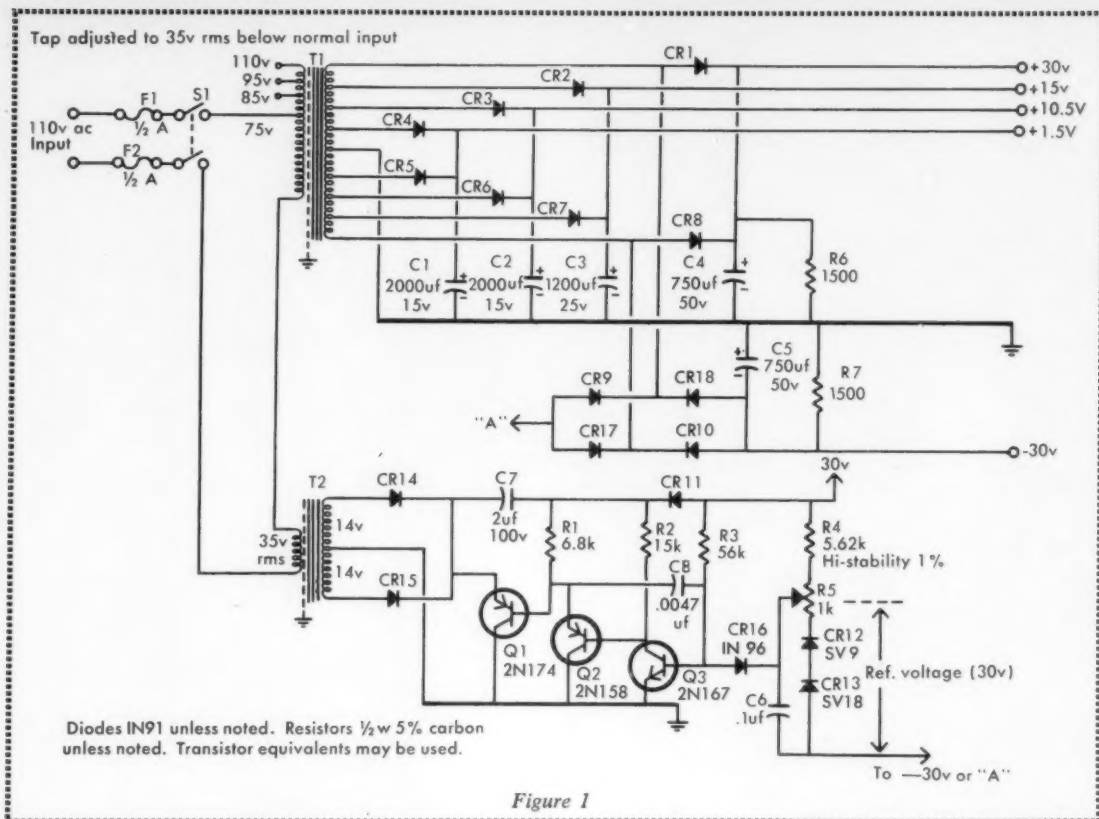
In a vertical generator, provision for space at the top injection end is necessarily more circumscribed. However, the vertical generator has its compensations. All the engineering problems are considerably simplified, and, as there is no experience in England of building horizontal generators, this was an important factor in the decision to build a vertical one. Weight in the centre terminal presents no problems, so that there is the possibility of building, for example, a positive ion source in the centre terminal and using it as a conventional single-ended generator as well as a tandem, so covering a much wider range of energy with the one machine.

Finally, the vertical machine has an advantage in operation which is being exploited at Harwell. With a vertical machine, one can deflect the beam through 90 degrees by a magnet which rotates about a vertical axis, the axis of the beam. In this way, the beam can be deflected readily from one experiment to another. The

(Continued on page 30)



Section diagram of the tandem generator. Length of each section of the stack is 14', over-all height is about 45'



Pulse circuits permit the use of a ...

General purpose transistor power supply

F. S. GOULDING & R. A. MCNAUGHT*

This power supply has been designed for use in transistor pulse circuits. Output voltages of +30, +15, +10.5, +1.5 and -30 are available which do not change by more than $\pm 3\%$ for changes from zero to full load and supply voltage variations of $\pm 10\%$. Stabilization is achieved by controlling the ac fed to the transformer

In designing transistor instruments, it is convenient to have available several voltage lines. These provide matching voltages used to define the voltage levels in the circuit and allow the designer to operate each transistor close to its optimum operating point. Also it simplifies circuit design if the voltage supplies are stable to the same degree as the better resistors, capacitors, etc. Generally speaking, an accuracy of $\pm 3\%$ is quite adequate for the purpose and ripple of the same order of magnitude can be tolerated. The supply described here was designed to meet these re-

quirements and to have adequate capacity to feed circuits containing as many as 200 transistors.

The general characteristics of the power supply are listed in Table 1.

Circuit description

Fig. 1 shows the circuit of the unit. Transformer T_1 is the main power transformer and the outputs from its secondary drive full-wave rectifiers and capacitor filters to provide the dc output voltages (e.g., CR_1 , CR_8 , C_4 produce +30v). The full input voltage is not fed to the primary of T_1 ; instead, a transformer T_2 drops some of the mains voltage so that only about three quarters of the input voltage appears on the primary of T_1 . The drop in voltage in transformer T_2 is controlled by the transistor regulator containing Q_1 , Q_2 , Q_3 , which operates on the difference signal between the -30v dc output and a reference voltage developed mainly by Zener diodes CR_{12} , CR_{13} . Alternatively, the reference voltage may be compared with the raw output of the full-wave rectifiers CR_{17} , CR_{18} . The choice between these two alternatives will be discussed later.

Operation of the transistor regulator is best understood

*Atomic Energy of Canada Ltd., Electronics Branch, Chalk River, Ontario

by first considering the situation when diode CR₁₄ is non-conducting. In this case, the current flowing in R₂ drives the base of n-p-n transistor Q₂ and the collector of Q₂ bottoms (or saturates). The voltage at the base of p-n-p transistor Q₂ is therefore practically zero and, due to the emitter follower action of Q₂, the base and emitter of Q₁ are at a similar potential. Thus, the full-wave rectifiers CR₁₄ and CR₁₅ almost short out the secondary of T₂ and, in this condition, the ac voltage-drop in the primary of T₂ is practically zero. Therefore, the mains input waveform is effectively connected directly to the primary of transformer T₁ when CR₁₄ is nonconducting. On the other hand, if CR₁₄ is conducting heavily, Q₂ is nonconducting and the bases of Q₂ and Q₁ sit at a positive potential (approximately 30v). In this case, the secondary circuit of T₂ presents a high impedance to the transformer and a substantial voltage drop appears across its primary.

Whether diode CR₁₄ is conducting or not depends upon the voltage on the cathode of the diode. If this is below ground potential CR₁₄ is conducting; if it is appreciably above ground potential CR₁₄ is nonconducting. Zener diodes CR₁₂, CR₁₃ drop approximately 27 volts, and preset potentiometer R₂ is adjusted so that a total reference voltage of 30 volts is available. Thus, if the voltage at the control point (connected to -30 volt output or A) is more negative than -30 volts, diode CR₁₄ conducts and some of the mains voltage waveform is dropped by transformer T₂. If the voltage is more positive than -30 volts, CR₁₄ is nonconducting and the full mains waveform appears across the primary of T₁. In normal operation the ripple at the control point (either -30 volt output or A) causes the

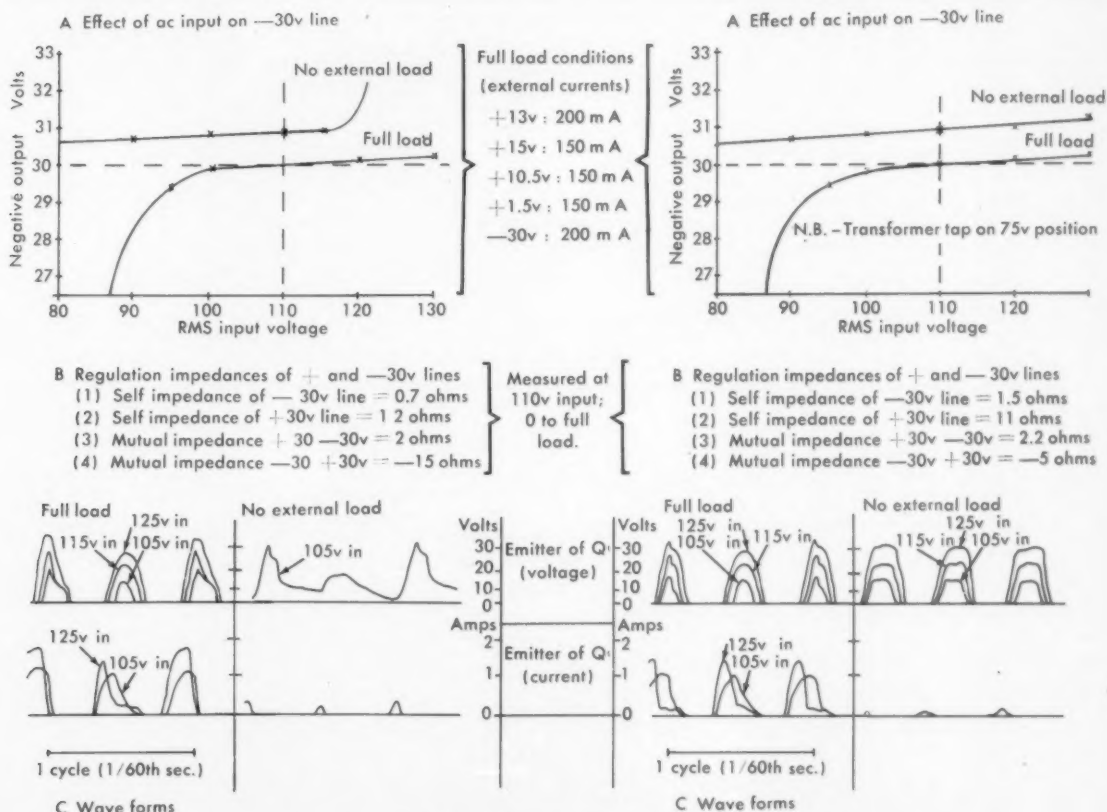
Table 1

Input voltage	Output			
	Voltage vdc	Current ma	Max. Ripple peak-to- peak volts	Impe- dance ohms
110 v ± 10% 60 cps.	+ 30	200	2	11
	+ 15	150	1	
	+ 10.5	100	0.5	1.5
	+ 1.5	50	0.25	
	— 30	200	2	

A mutual impedance exists between all voltage lines:
Voltage change on —30v when 200 ma load is put on +30v is +0.4v.
Voltage change on +30v when 200 ma load is put on —30v is +1v.

control circuit to switch on and off at various parts of the mains cycle so as to maintain the -30 volts very close to its correct value.

The waveforms given in Figs. 2 and 3 illustrate the operation of the circuit. The curves in Fig. 2 result when point A is used to feed the control circuit. The voltage



Regulation curves and waveforms

Fig. 3. Control attached to -30v line

Fig. 2. Control attached to point A

drop across the primary of T_2 , and therefore the loss in mains voltage applied to the primary of T_1 , is related to the voltage waveform at the emitter of Q_1 . As seen in Fig. 2C this waveform consists of an almost half-sinusoid peak on both positive and negative peaks of the mains cycle. The amplitude of the half-sinusoid peaks is dependent upon the mains input voltage and upon the load on the power supply outputs. The full-wave action of CR_{14} and CR_{15} and voltage step-up of T_2 (secondary to primary) result in these voltage peaks being subtracted from the ac mains waveform, resulting in a square-topped input waveform to T_1 . Fig. 2C also contains a drawing of the current waveform in the emitter of Q_1 . As might be expected the current waveform peaks at the time when the filter capacitors in the power supply are being recharged just before the peak of the mains input cycle. Thus, the current flowing in Q_1 has fallen well below its maximum value when the voltage at the emitter reaches its peak, thereby reducing the power dissipation in the transistor to a reasonably low value. A simple measurement taken from the data plotted in Fig. 2C shows that the instantaneous power in Q_1 does not exceed 15 watts and that the mean power is an order of magnitude less than this.

The waveforms of Fig. 3, applying to the case where the -30 volt output feeds the control circuit, are quite similar to those of Fig. 2 except under no load conditions. Under these conditions, the ripple voltage on the -30 volts is very small and Q_3 remains partially cut off all the time. This does not result in a serious dissipation problem in Q_1 but, nevertheless, it is recommended that supplies designed to operate over a wide range of loads, including no load, should be controlled from point A in Fig. 1. The extra cost of two diodes seems to be a small price to pay for the knowledge that the operating conditions of the control circuit are well defined.

The effect of capacitor C_6 on the operation of the supply is of interest. In the absence of this capacitor the control loop is unstable and oscillations (approximately 5kc) occur on alternate half-cycles of operation. Some evidence of this instability can be seen on the front edge of alternate peaks in Figs. 2C and 3C. Capacitor C_6 acts as an integrating capacitor which reduces the gain of the loop by a substantial factor at high frequencies.

The function of C_7 and CR_{11} may also seem puzzling. The purpose of this arrangement is to maintain a constant voltage (30v) across R_1 and R_2 , thereby ensuring that the current in these resistors always swamps the collector leakage currents of Q_1 and $Q_2 + Q_3$ respectively.

The regulation curves for the two types of supply are also shown in Figs. 2 and 3. Fig. 2A shows that a variation of $\pm 10\%$ on the nominal 110-volt mains input, together with a variation from zero to full load on all outputs, results in a variation of less than $\pm 2.5\%$ in the -30 volt output. The arrangement is equally successful in stabilizing the other output voltages against mains variations but load changes on the other outputs produce appreciable changes in the output voltages. Since the stabilizer system only operates on the negative peaks of the transformer secondary waveform, the output impedance of the positive supplies is the same as it would be with no stabilizer circuit. For example, the +30-volt line has an internal impedance of 11 Ω . This is considered to be low enough for most purposes and no effort has been made to improve the supply in this regard (e.g., by using a full-wave bridge circuit to feed the regulator and thereby stabilize the peak to peak waveform).

The curves of Fig. 3 are similar to those of Fig. 2 but again the peculiar behavior of the supply on no load at high input voltages is apparent. It will be seen that use of point A (Fig. 1) for control, as shown in the curves of Fig. 2, results in improved performance on no load. The performance is similar in other respects.

The design of transformers presents some unusual problems. T_2 must be designed to drop as little voltage as possible when the secondary is shorted out (i.e., low primary resistance and small leakage inductance). Also the magnetizing current of T_1 must be made as small as possible to save the regulator from handling extra current. The transformers used here were chosen with these factors in mind and, since small size was also a requirement, a "C" core was used in transformer T_2 . END

Acknowledgements

The authors acknowledge the help of W. C. MacGregor who constructed the first of these units and carried out measurements on it. N. McLeod was responsible for the diagrams included in this report.

Tandem generators — continued

beam can be moved to any point of three target rooms, which are disposed in a semi-circle whose centre is the tower axis.

The inside diameter of the pressure vessel is nine feet, the length of each section of stack 14 feet; over-all height of machine is about 45 feet. The vessel is made so that only the lid is removable. The rest of the vessel is a permanent fixture, and access to the stack for servicing is by an internal hoist.

Progress to date

Progress on the machines has been satisfactory. The engineering components are at the time of writing⁶ mostly complete, while one of the major items, the first pressure vessel, has been delivered to the Aldermaston Site.

For the ion source, emphasis has been placed on the type described by Tuck and Phillips.⁶ The attraction of this source is its simplicity. It is, in effect, a positive ion source of the radio-frequency type, with the focusing voltage reversed. With this source, 10 to 15 microamperes of negative ions have been obtained. The negative ions are produced by charge (electron) exchange in the canal through which ions and neutral atoms emerge. The

optimum pressure for charge exchange is substantially different from the optimum pressure for positive ion extraction, so that the next development will be the transmission of a positive ion beam through a suitable exchange medium, whose pressure is independently controlled.

For the stripper, foils of thickness 10-20 $\mu\text{g}/\text{cm}^2$, and area $\frac{1}{2}$ -inch diameter have been developed which are capable of transmitting without rupture beam densities of 100 microamperes per square centimetre. Here again, however, the attraction is that of simplicity. From the technical point of view, the gas stripper has several advantages, and probably will be used. The central stripper section has been designed to employ either foil or gas strippers.

It is not easy to make accurate forecasts of the commissioning of these machines. Early in 1959 is the expected date of initial operation. END

REFERENCES:

- 1 Herb, R. G., Parkinson, D. B., and Kerst, D. W. *Phys. Rev.* 51, 75 (1937).
- 2 Bennett, W. H., U. S. Patent 2,206,558.
- 3 Kallmann, H., U. S. Patent 2,213,140.
- 4 Alvarez, L. W., *Rev. Sci. Inst.* 22,705 (1951).
- 5 Phillips, J. A. and Tuck, J. L., *Rev. Sci. Inst.* 27, 97.
- 6 Written August 1958.



Dr. Carmichael adjusts trays of geiger counters surrounding a spherical ion chamber covered by lead hemisphere

H. CARMICHAEL, PHD.*

By 1948 scientists had conducted experiments that showed the nature of cosmic radiation. However, it was not until the advent of radio astronomy that they were able to gather data that finally led to Ginzburg's theory on the origin of cosmic radiation

Radio astronomy helps establish theory of . . . Cosmic radiation and its origin

Although the existence of cosmic radiation was established in 1912, the true nature of the radiation in space, before it enters the earth's atmosphere, remained unknown for some 36 years. The radiation was first thought to be a very short wavelength gamma radiation; then, when the effect of the magnetic field of the earth on the intensity was discovered, it was thought to consist of electrons; later, the electron hypothesis was abandoned in favour of protons. Finally, in 1948, the tracks of primary cosmic rays were observed in photographic emulsions which had been exposed for several hours by means of balloons at a height of around 100,000 feet; then it was shown that atoms of all the more common elements were present and that the relative abundances of the various elements were quite similar to their known abundances in the universe. Some 91.5% of the cosmic rays are protons (hydrogen atoms), 8% are alpha particles (helium atoms), and the remaining 1/2% are heavier atoms up to iron. The proportion of heavy atoms is actually several times as great as is found for the universe as a whole.

It is natural to ask immediately, do these particles reach the earth with equal intensity from all directions in space, or do they come preferentially, say, from the sun or from the milky way? The answer to this question is that there does not seem to be any preferred direction of arrival. Neither has any change of intensity with time been found that cannot be explained as due to a purely local influence of the sun.

Another result of quite recent investigation is that, in proportion to their mass, the various kinds of atoms seem to have the same distribution of energies. This distribution

extends from a low energy limit at a little less than 10^9 electron volts (for the protons), with ever-decreasing intensity to the stupendous figure of 10^{18} ev with no clear upper limit yet in sight. The lower limit is probably a local cut-off effect produced by the sun. The energy spectrum is approximately a power law with the number of particles of more than any given energy of each element decreasing inversely as the square of the energy.

The flux of particles is about $0.3 \text{ cm}^{-2} \text{ sec}^{-1} \text{ sterad}^{-1}$ and the total energy of cosmic radiation in the vicinity of the earth is about 1 ev cm^{-3} . This may be compared with 0.3 ev cm^{-3} for starlight, 1 ev cm^{-3} for the kinetic energy of gas turbulence, and 1 ev cm^{-3} for the magnetic field energy in galactic space. Thus, the energy density of cosmic radiation is comparable with the density of other forms of energy in interstellar space in the galaxy.

The problem of the origin of cosmic radiation, needless to say, has been one of the most baffling in physics and also in astronomy. Where do the particles originate and how do they acquire such very large energies? Do they fill all space, only the galaxy, or only the solar system? It has been seriously argued, even within the past 10 years, that cosmic rays that we observe all come from the sun and that they spend their lives circulating in and near the solar system, held there and rendered isotropic by disordered magnetic fields. Another theory proposes that cosmic rays originated at the creation of the universe and have been in space ever since. Clearly a means of detecting the presence of cosmic rays in distant parts of the universe would be very useful, particularly if strong sources of cosmic rays could be identified, for example in supernovae, or other celestial objects which are known to be capable of pouring out an enormous flux of energy.

*Atomic Energy of Canada Ltd., Chalk River, Ontario.



Twenty-two ton pile of graphite blocks enclose a detector which continuously measured cosmic ray neutrons for the International Geophysical Year program

Distribution of cosmic radiation in space

A major advance was made in 1950 when the astronomer Kiepenheuer suggested that non thermal radio noise indicated the presence of electrons of cosmic ray energies. This idea was vigorously developed by the Russian theoretician, Ginzburg, who, two years ago, published a very clear and well constructed theory of cosmic radiation¹. It is interesting to note that nearly all the experimental results quoted by Ginzburg were obtained in the west. He also generously acknowledged and appraised all previous work of western theorists in this field. I shall now attempt to give an outline of Ginzburg's theory and begin with some discussion of radio-astronomy.

Radio astronomy located non-thermal radio noise

In the years 1950-53, the new science of radio-astronomy began to map out a radiation from space in the metre band which had puzzling properties. When radio noise is received in a known solid angle at a given wavelength, it is possible, from the measured power received, to assign an effective temperature to the source, and the power received from this same source at all other wavelengths should be consistent with this effective temperature. Now, for example, the general cosmic radio emission from the direction of the galactic centre indicates an effective temperature of 3×10^5 °C at 16 m, 10^6 °C at 33 m and about 10^8 °C at 140 m. Evidently this radiation is not of thermal origin. Similarly, the radio noise from certain nebulae is non-thermal and also the noise from centres of disturbance on the sun which sometimes reach an effective temperature in excess of 10^{13} °C. It was suggested by Kiepenheuer, that non thermal radio noise is synchrotron radiation from high energy electrons moving in magnetic fields.

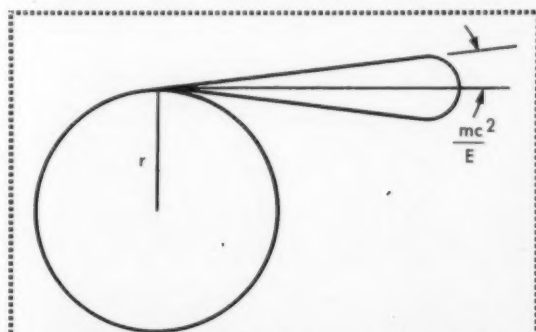
In 1947, during the operation of a 70 Mev synchrotron at the General Electric Company, Schenectady, visible radiation from high energy electrons circulating in a magnetic field was observed. The existence of radiation from accelerated electrons had been predicted in 1898 and its effect on the operation of a betatron was pointed out in 1944 by two Russian physicists. The frequency distribution of the radiation was later calculated by Vladimirovski and also by Schwinger.

It will be helpful to describe the manner in which synchrotron radiation arises. An electron moving along an

arc of a circle radiates because of the acceleration towards the centre. The electric vector of the radiation is in a plane containing the radius of the arc. When the energy E of the electron is much greater than its rest energy mc^2 the radiation is thrown into a narrow cone within an angle mc^2/E with the motion of the electron along the arc as shown in the diagram. An observer in the plane of the orbit, therefore, receives single short pulses of plane polarized radiation, each one emitted when the electron is moving towards him. The duration of the pulses is severely curtailed by Doppler effect since the electron's speed is close to the velocity of light. The frequency distribution of the energy radiated per unit time has a strong maximum associated with the duration of the pulses. The frequency at the maximum is

$$\nu = \frac{1}{4\pi} \frac{eH}{mc} \left(\frac{E}{mc^2} \right)^2 = 1.4 \times 10^6 H \left(\frac{E}{mc^2} \right)^2$$

where H is in oersteds and is the component of the magnetic field perpendicular to the direction of motion of the electron, E is in electron volts, and $mc^2 = 5 \times 10^5$ ev. In interstellar space in our galaxy it is known that magnetic fields of about $H = 10^{-5}$ oersteds exist. Therefore, radio noise of frequency 300 mc, if observed, would indicate the presence of cosmic ray electrons of energy $E = 2 \times 10^9$ ev.



An electron moving along an arc of a circle radiates because of the acceleration toward the centre

Supernovae

In 1054 the Chinese recorded a new star which remained visible by day for more than three weeks and by night for 22 months. In the same region of the sky today, there is a gaseous nebula, the Crab nebula, which is still expanding at a rate consistent with the explosion of a star 900 years ago. This nebula is a strong source of non-thermal radio emission and, furthermore, the visible light from the nebula is almost completely plane polarized. Synchrotron radiation is the only known source of such strongly polarized light. It follows, if the magnetic field in that nebula is taken as 10^{-3} oersteds, that electrons of energies up to 10^{12} ev must be present. If these electrons have attained their energies through the Fermi mechanism of statistical acceleration in turbulent magnetic fields, protons of 10^3 times this energy must be present and heavier nuclei of still greater energy in proportion to their mass. Thus, this supernova has been, and probably still is, a strong source of cosmic radiation. At least six such remnants of historical supernovae are known in our galaxy and the rate of occurrence, including those that we do not see because of interstellar absorption, is believed to be about two per century. Each supernova probably emits cosmic rays for many hundreds of years while the shell is expanding.

The galactic halo

In addition to the emission from discrete sources, there exists a general background of non-thermal radio noise which appears to originate from a spherical volume in which our galaxy forms a diametrical plane. A similar noise halo surrounding the distant galaxy in Andromeda has been detected. The radio noise from these galactic halos indicates the presence of electrons with energy around 10^9 ev moving in the magnetic fields of about 10^{-5} oersteds which are known to exist in the galactic arms and in the galactic halo. Therefore, Ginzburg assumes that cosmic ray atoms are also present and that the halo of our galaxy of diameter 10^{23} cm, by means of its magnetic fields, can retain these cosmic rays so that they do not tend to leak out freely into intergalactic space.

The cosmic ray energy balance

Ginzburg now assumes that the principal (and also an experimentally proven) source of cosmic radiation is in the supernovae and that the radiation fills the galaxy and its halo but not intergalactic space (this being also experimentally proven). Even the sun, on a few occasions during the past 20 years has, for times of a few minutes duration, emitted cosmic rays. However, the amount of cosmic ray energy likely to be provided by all the more common kinds of stars is far too small to replenish the absorption of cosmic radiation in the galaxy.

The power required can readily be estimated. The amount of matter that high energy protons can penetrate before their number is reduced by factor 'e' is known, and the concentration of the residual gas in the galaxy and in the halo is known. If we take this concentration to be an average of 0.1 atoms per cm^3 , then cosmic ray protons will have a mean life of about 10^9 years. The total energy of cosmic rays in the galaxy is the volume of the spherical halo which is 10^{68}cm^3 multiplied by the energy density which we saw was 1 ev per cm^3 . The rate of energy loss is, therefore, $10^{68}/10^9 = 10^{59}$ ev per year (10^{47} ergs per year).

Now, within the Crab nebula, Ginzburg quotes one estimate that some 10^{60} ev of energy has been communicated to electrons during the life of the nebula since 1054. We may assume that at least 1,000 times this amount has been communicated to atoms — say 10^{63} ev. Since at least one supernova per century occurs in the galaxy, the total energy converted to high energy particles within supernovae is about $10^{63} \times 10/10^3 = 10^{61}$ ev per year. This is 100 times the amount needed and so it seems that supernovae have ample power to be the source of cosmic radiation.

A number of other facts about cosmic rays are consistent with the supernovae theory of the origin. For example, the unusually large proportion of heavy nuclei in cosmic rays indicates that they must come from stars such as supernovae where atom building has proceeded a long way. END

REFERENCE:

1. *Progress in Elementary Particle and Cosmic Ray Physics*, Vol 4, chapter 5. Interscience Publishers Inc., New York

In 1937 Dr. Carmichael was a member of the Wordie Expedition to Baffin Bay and Ellesmere Island. He measured cosmic radiation by flying his apparatus with free balloons to a height of 18 miles in the vicinity of the North Geomagnetic Pole. For 20 years these were the only measurements made at such a high latitude and altitude, obtained near the time of the maximum of the solar cycle. They have been confirmed by recent measurements.

The material in this article was presented by Dr. Carmichael at the 1958 IRE Canadian Convention. Additional interesting information was presented by the other four authors during this session on cosmic radiation. In particular, Dr. J. F. Steljes (Automatic counting and pulse height analysis for cosmic rays) described the instruments shown in the illustrations on pages 31 and 32.

Airborne radio survey — continued

their working capital is often quite limited. Recently enacted government legislation also permits additional competition from shoestring operators that will add to their problems.

Some of the respondents' comments are instructive.

The charge concerning lack of suitable helicopter radio equipment is serious and warrants careful investigation by the manufacturers. Some suggestions are incorporated in existing designs. For example, the Collins 51X-3 receiver has extremely reliable, easy-to-use tuning. Dare claim that their R-5A's micro-tuner mechanism permits channel selection without the use of crystals. Lightweight transistorized power supplies and modulators are marketed by several manufacturers. Possibly the operators are scared off by the

prices of these improvements, or, more likely, a better selling job by the manufacturers is called for.

Some replies to questions relating to expected price and buying aircraft abroad probably reflected the respondents' ego and their desire to seem generous or patriotic rather than mean. Thus they may not be prepared to pay as much as \$2,000 per system, on average; or to buy a Canadian built system, although 20% said that they would.

Even the supposedly rational motivation of the industrial buyer is difficult to analyse scientifically, in every detail. Where possible, the results of the survey were compared with information obtained from other sources, and from the author's own experience. This indicated that the sample had given fairly accurate results. END

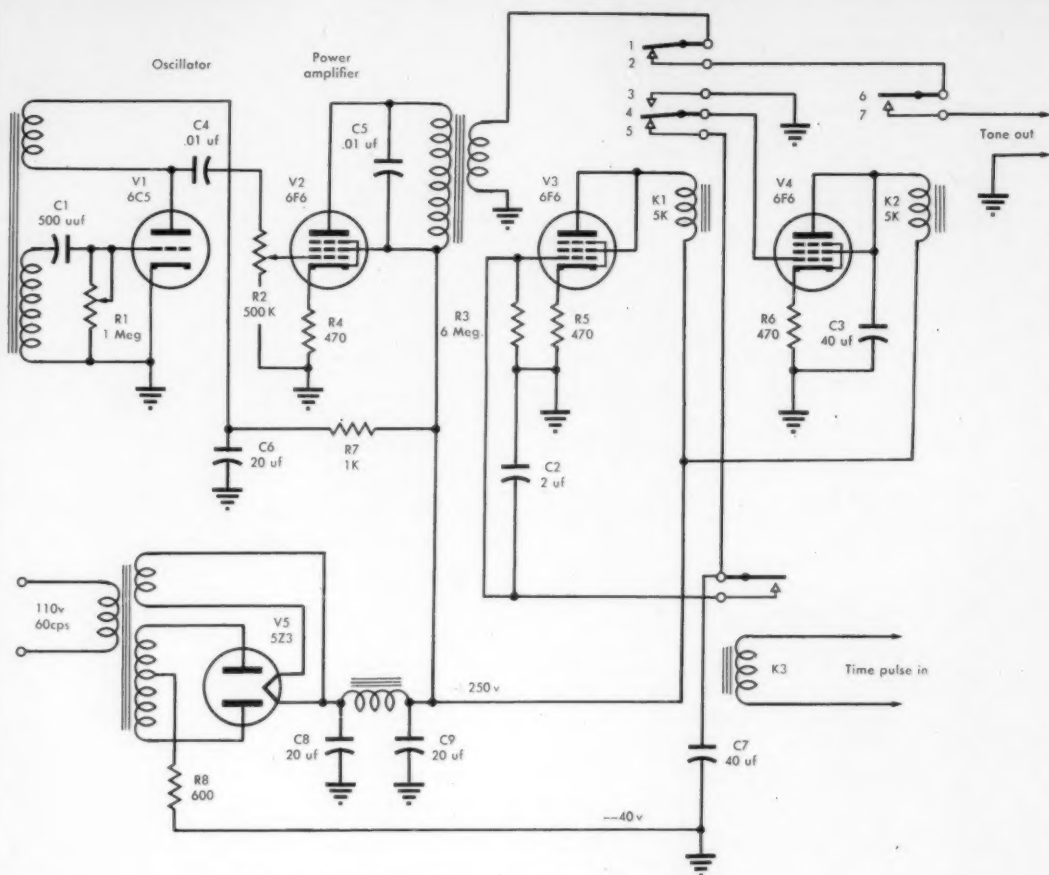


Fig. 1. The five minute signal generator and 600 cps tone generator

McGill Observatory signals trigger . . .

CKAC studio clock synchronizing system

L. SPENCER & R. DOIRON*

Fractional-second pulses received every two seconds from McGill University Observatory are used to trigger signal and tone generators. The generators form part of a system for the remote correction of broadcast studio clocks from their control booths.

Having installed a generator which emitted a one second duration tone of 1000 cps every hour, the gating of which was controlled by an accurate time pulse signal developed by McGill University Observatory, our next problem was a system for correcting or synchronizing our existing ac electric clocks to within one second of McGill time. The clocks in the broadcasting studios were to be corrected by remote control from the adjoining control booths.

These are medium priced clocks with a 12-in. face, each connected to its own double throw toggle switch in the control booth. The 72 cps power supply is fed to each

*Radio Station CKAC, Montreal.

studio control booth.

The time pulse signal has a pulse interruption of 72 seconds prior to every hour and 12 seconds prior to every five minute interval. The 72 seconds blank controls the hourly 1000 cps tone and the 12 second blank actuates a half-second 600 cps tone every five minutes. This 600 cps tone is fed to speakers in the master control room and the individual control booths, for clock correction purposes. If clocks are fast, the clock power supply is interrupted until the required time is lost. If clocks are slow they are switched from the 110 volt 60 cps power line to a 110 volt 72 cps power supply. The clocks now gain 12 seconds every minute, or one second every five seconds.

The generator used to provide the 1000 cps tone for broadcast at every hour was described in the January 1959 issue of CEE.

This article is a description of the second signal generator developed to use the 12 second blank prior to each five minute interval. It incorporates the 600 cps tone signal to differentiate between the hour signal and the five minute signal.

Fig. 1 shows the 5-minute signal and 600 cps tone generator. During the time pulse periods, relay K3 closes every two seconds, charging C2 to -40 volts. V3 is kept in cut-off condition and relay K1 is not activated. Tone contacts 1 and 2 of K1 remain closed and contacts 4 and 5 also remain closed applying -40 volts bias to V4.

Relay K2 remains de-energized, leaving contacts 6 and 7 open to prevent the 600 cps tone from reaching the speakers.

On time pulse interruption, R3 discharges C2 to near ground potential in approximately 8 seconds. Thus, prior to every five minutes V3 actuates K1 after the first eight seconds of the 12 second blank. This opens tone contacts 1 and 2, and closes contacts 3 and 4 to ground the grid of V4. Relay K2 is actuated to close contacts 6 and 7. The generator is now ready to emit a 1/2-second tone.

On completion of the full 12-second blank, the first pulse charges C2 to -40 volts, biasing V3 to cut-off. Relay K1 releases immediately closing tone contacts 1 and 2, and applying -40 volts bias to V4 by closing contacts 4 and 5. However, K2 cannot release immediately due to charging of C3 through the relay coil. The constants have been chosen so that the delay will permit the 600 cps tone to be transmitted to the speakers for 1/2 second every five minutes.

The oscillator frequency is determined by the R1C1 time constant. Tone amplitude is controlled by R2 and the tone duration is controlled by C3 and the resistance of the coil of K2.

Fig. 2 shows the 72 cps power supply for the clocks. It has been designed to deliver approximately 20 watts at 110 volts as determined by the setting of R2. R1C1 time constant was selected to provide an oscillator frequency of 72 cps.

The operators in the individual control booths regulate the clocks in the studios by checking them against the 600 cps tone every five minutes. The switches in the control booths permit the operators to speed up or retard the clocks as necessary.

END

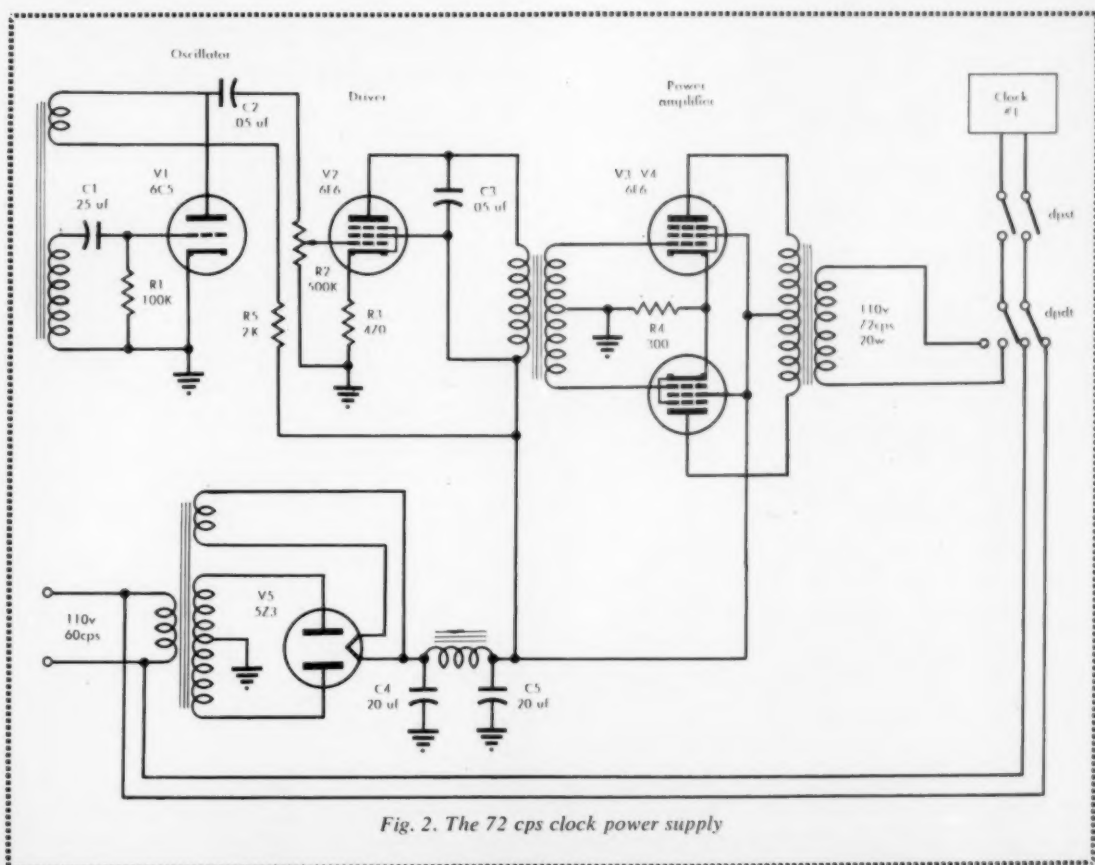
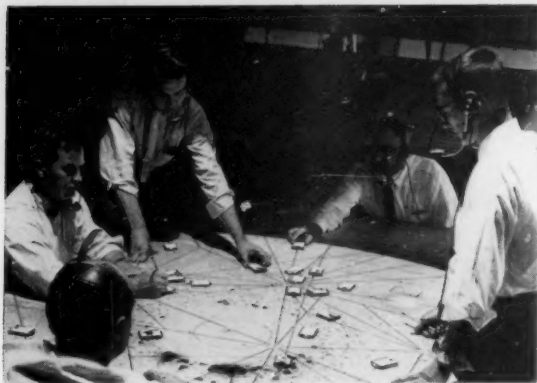


Fig. 2. The 72 cps clock power supply



Rapid film processor aids radar operators

In recent years a number of accidents have happened to ships and to aircraft despite the fact that the most up-to-date radar equipment has been employed to prevent them. At a loss for a better explanation, the excuse offered has been "radar blindness," which, it is alleged, can afflict an otherwise healthy and efficient watcher who has to look too long at a flickering crt.

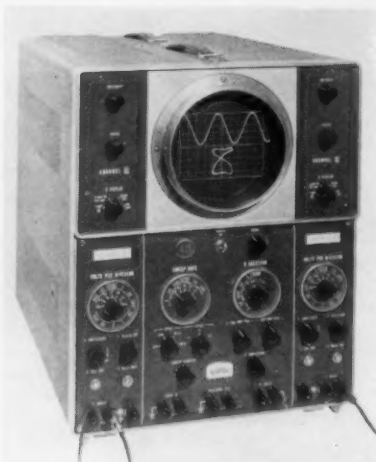
There has also been another problem associated with cathode ray tubes—the difficulty of permanently recording the information they present at the same time as the tube is used for immediate projection of its data. These problems have led to the rapid processing photographic projector designed by Kelvin and Hughes Ltd., London, and developed in co-operation with Britain's Ministry of Supply.

The new equipment is now in production and three of the first sets have been bought by the Civil Aeronautics Administration of the United States to help solve air traffic control radar problems.

A photographic record is made of the radar tube, developed by the equipment and projected on to a large screen. The processing cycle can take as little as six seconds and the film then acts as a permanent record.

Films and processing solutions have been designed specifically for the equipment by Ilford Ltd., London.

Engineering reports



Dual-beam oscilloscope uses multi-gun crt

Allen B. Du Mont Laboratories, Inc., have introduced a dual-beam oscilloscope which is capable of displaying x-y plots and simultaneously displaying either the x or y signal against time. It can develop nine major modes of display, and by introducing z-axis modulation can display 27 additional modes.

Because the calibrated sweep is generated at a high level, it can be fed directly into the horizontal deflection plates without amplification. Therefore, it is possible to use on gun of the crt as a single beam oscilloscope having identical amplifiers, while either the x or y input of this display can be simultaneously presented against time on the other channel.

A true dual-beam oscilloscope, the Type 411 employs a multi-gun crt rather than an electronic switch or beam-splitting. Independent control of each electron beam is available at the front panel. Each channel has its own focus and intensity controls, and either beam may be switched off when not in use.

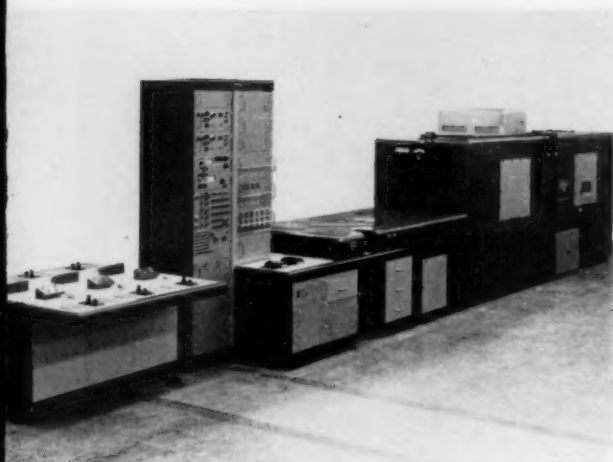
The type 5ARP mono-accelerator tube operates at 2500 volts acceleration and is a two-gun electrostatic deflection and focus crt. Each gun is independent of the other except for the accelerators and the pattern adjustment electrodes.

Frequency response of the Type 411 extends from dc to beyond 100 kc, and the instrument features a full-scale amplitude measuring range of from one millivolt to 500 volts in 17 steps.

An electronic shutter can be triggered to turn on the crt display for a pre-determined time, thereby presenting the desired portion of a transient during x and y plotting.

The Canadian price of the Type 411 is approximately \$1,100, sales tax extra.

This is the start of a new feature in CEE. News of products and processes having a high degree of reader interest will be published as engineering reports



Machine tests transistor automatically

Transistors can now be tested automatically in this modular testing station built by Stromberg-Carlson for the Sperry Gyroscope Company. It will process any type of transistor through seven successive tests, at rates up to 430 transistors per hour.

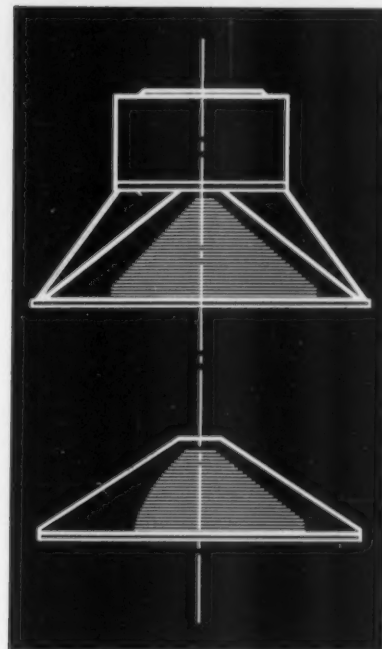
It was designed to test transistors rapidly and economically for stringent military requirements. Accuracy can be maintained within $\pm 2\%$ of the range. However, due to the modular construction, the machine can be changed to other tolerances by substitution of a few plug-in modules.

The machine will test dc beta (pulse test), ac beta (small signal), saturation and leakage. The additional test positions provide for testing these parameters by more than one method, or additional parameters, if desired. Transistors that fail any one of the tests are ejected automatically at the station at which they fail. Thus, the machine sorts rejected transistors according to their defects.

A feature of the original machine is a temperature chamber in which the transistors can be subjected to any of the tests in the series while being operated at pre-selected temperatures up to 200C.

Operation of the machine is completely automatic, requiring only one operator to load it. An additional facility, called a remote test table, provides for greater output where less extensive tests are needed. With up to six operators, working at this table, as many as 2,000 transistors can be tested per hour.

Another similar machine is being built to test diodes. Additional development work is in progress on different modules so that the original machine can be used to test other components, such as capacitors, resistors and transformers.



Electrostrictive ceramic drives loud speaker

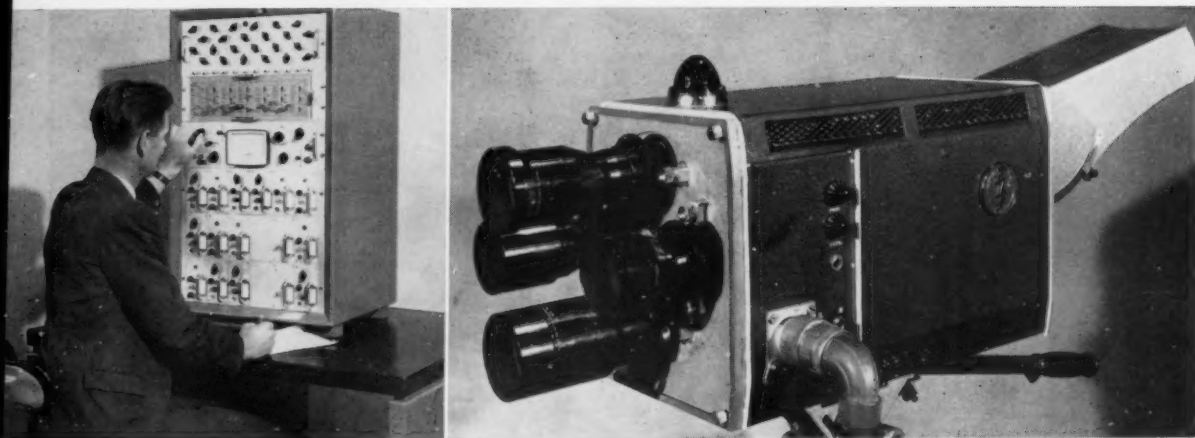
Low cost, featherweight radio loud speakers are now possible with the development of an electrostrictive ceramic by the Mullenbach Division of Electric Machinery Mfg. Co. Baked in the form of thin discs, a few thousandths of an inch thick, the ceramics are compounds of barium titanate. They respond to fluctuations in electrostatic fields, contracting radially with increases in the applied field. Bonded to a larger titanium disc, they produce a cupping action that in turn drives a speaker cone.

In building a speaker, a ceramic-metal-ceramic sandwich disc is riveted to the speaker frame at the hub, and the rim of the disc assembly is glued to the floating apex of the speaker cone.

No modification is needed in the radio circuitry to adapt it to the ceramic loudspeaker. Breakdown voltage for the ceramic is 1500 to 3000 volts.

Besides the speaker drives, the ceramics are being developed for compact metering manometers, non-magnetic switches for recording devices, and rapid acting relays for computing circuitry.

Stacked in parallel hookup, they can be used as actuators to produce pressure peaks as high as 30,000 psi.



New Canadian company has wide range of products

Since its formation two years ago, E.M.I. Electronics Ltd. has expanded rapidly and introduced many products to the market. This will have increasing significance in Canada now that the company has acquired control of Cossor (Canada) Ltd. The new Canadian company will operate under the name of E.M.I.—Cossor Electronics Ltd. with headquarters at Halifax, Nova Scotia.

One of the new products introduced is the vidicon camera channel type 201. It employs printed circuits and plug-in techniques to reduce size and weight while improving reliability and facilitating servicing. It is capable of operating on 405, 525 or 625 line standards.

For color television, the camera channel type 203 can use any one of three types of tube—the CPS Emitron, 3" image orthicon, or the 4½" image orthicon. It has been designed to operate on 405, 525 or 625 line standards.

E.M.I.'s general purpose analog computer EMIAC II has been designed in such a way that two or more machines can be combined to build up a computing system of the desired capacity and flexibility. The patch panel can be removed while the solution to the previous problem is being prepared by the computer.

The EMIRAD hand and clothing monitor type I can be used to detect simultaneously two types of radiation contamination on the hands and clothing of workers in nuclear energy establishments. This is achieved by the use of a system of dual phosphor scintillation.

A series of EMIDATA components have been introduced as ancillary data processing equipment. The 1" tape deck combines high speed with fast start, stop and reverse times. Bi-directional tape speeds of 200 in/sec, with start and stop times of 4 milliseconds, are achieved by a vacuum capstan.

The instrumentation tape deck has been designed for data processing. Four of its speeds within the range of ½ to 120 in/sec can be selected instantaneously, and up to 24 channels on one inch tape provided.

Magnetic drum stores are available with capacities of 8,000 or 16,000 words.

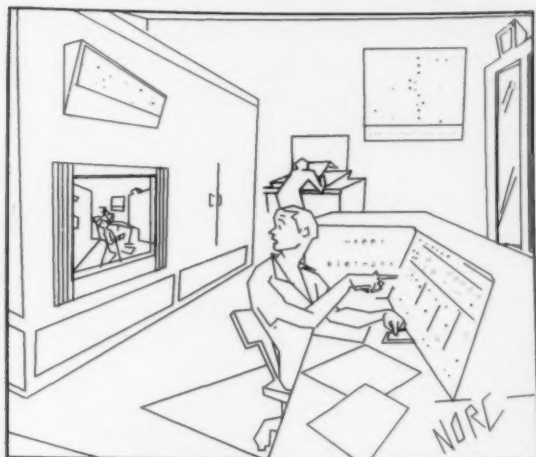


This record player is truly portable

"A world of music in the palm of your hand" is the sales slogan for this miniature, battery-driven record player. It does away with the turntable and simply provides a drive at the centre of the record for either 45 or 33 rpm. The Wondergram, designed by Ambassador Radio & Television Ltd., London, measures 8½ x 4½ x 1¼ inches and weighs only 2 lb.

To operate, the lid is lifted and the record placed on the spindle, then the lid is closed to hold the record in place and start the motor. Seven, ten and twelve-inch records can be played.

The amplifier uses a printed circuit with transistor push-pull output. When not in use, the pickup arm rests beside the lid to form a compact instrument.



Microfilm recorder plots output from computer

Stromberg-Carlson has installed an S-C 4010 high speed microfilm recorder at the U. S. Naval Proving Ground, Virginia. The system, capable of recording up to 15,000 characters or 10,000 graph plotting points per second, is to be used to print tabular data and to plot graphs computed by the Naval Ordnance Research Calculator (NORC).

The NORC is a large, high-speed general purpose digital computer. When used in the system, it can provide high-speed graph plotting of complex mathematical formulas used for computing problems of satellite trajectory, spatial navigation and hydrodynamics.

The S-C 4010 consists of a Charactron shaped beam tube, electronic controls and logic circuitry. To provide a permanent photographic record it has a 35 mm Traid-Automax camera.

The NORC supplies all intelligence for the selection of alphabetical, numerical or graphical characters and their positioning on the screen of the Charactron tube. The characters are then projected from the tube face onto the 35 mm film for permanent record. Provision is made to advance the film under command of the computer.

A Kelvin-Hughes camera is used to permit direct viewing of data displayed on the Charactron tube face. Projected displays can be seen on a viewing screen incorporated in the cabinet in less than ten seconds after film exposure. This process may be used during the 35 mm film recording operation, and acts as a visual monitoring device.

The drawing was made by programming it into a NORC and displaying it on the S-C 4010 printer.



Audio instructions aid manufacturing

Audio instructed manufacturing operation (AIMO) is an audio method of conveying instructions to manufacturing workers. The essential parts of the system are two Dictaphone machines. One records the information required to instruct a worker while the other plays back the information to the worker who carries out the instructions as each step is described.

People can listen to and retain only limited amounts of information at a time. Accordingly, the recorder has an indicator that allows the instructor to identify successive blocks of information. The machine registers the number of the instruction block being recorded. The instructor, working from blueprints and plans, can dictate the instructions in blocks arranged in systematic order.

The operator controls the playback machine with a foot switch. Depressing it starts the machine and then it runs until a block space is ended, then it stops. When she is ready for the next instruction she depresses the switch again. She can back space a block if the instructions were missed or not clearly understood.

Several varieties of back-space controls and receivers are available to suit the requirements of the working conditions.



Calculator speeds office arithmetical work

The International Business Machines 632 Electronic Typing Calculator with Card Punch does the arithmetic on business forms as they are filled out by a typist, then punches the results into IBM cards for automatic processing by accounting machines.

The 632 will perform just about every standard office arithmetical chore: multiplying quantity times price and

automatically printing out the total on an invoice; figuring discounts; computing taxes. The operator is able to select the information to be punched into cards for further processing.

The 632 with Card Punch consists of an electric typewriter, a ten-key companion keyboard, a magnetic storage within the computer unit, a program reading device and an IBM Card Punch.

Instructions and decisions for a complete application are provided by a plastic tape within the program reading device. The tape can be changed for a different office procedure in a few seconds.



Computer helps control flight of jet aircraft

The Philco Transac C-1100 airborne computer uses transistors and plug-in printed circuit cards for flexibility, light weight and reliability. It is designed to handle all computational requirements necessary to control a jet aircraft from take-off to landing.

Applications are auto-pilot, air data (speed and altitude), cruise control (proper altitude for high fuel efficiency), automatic navigation and engine performance. In a military jet the C-1100 could compute weapon delivery and interception. In addition to aircraft control, the computer can be used for other mobile or industrial control applications.

Acceptance, processing and delivery of all data is done according to a stored digital program. The drum storage can retain from 1,500 to 5,000 instructions or numbers.

Manual switches are provided for making up to seven independent choices as to whether certain parts of the recorded program should or should not be executed.

The computer can perform 64,000 additions or take 16,000 square roots per second. It uses 3,500 transistors and has 20 core memory planes.

The system is designed around this compact, parallel, binary, digital computer of 20 bits word length.

The computer occupies less than three cubic feet, weighs about 150 lb., and uses 60 watts dc.

Statistical physics is assuming increasing importance

Elementary Statistical Physics

C. Kittel; John Wiley & Sons, Inc., New York; 228 pp; \$8.00.

Reviewed by H. Kaufman, Mathematics Department, McGill University, Montreal.

This book is based on a series of lectures given by Kittel to beginning graduate students at the University of California, Berkeley. Part 1, *Fundamental Principles of Statistical Mechanics*, consisting of 24 sections, includes accounts of the microcanonical, canonical, and grand canonical ensembles, Fermi-Dirac and Bose-Einstein distributions, thermodynamics and statistical mechanics of magnetization, density matrix and quantum statistical mechanics, and negative temperatures.

Part 2, *Fluctuations, Noise, and Irreversible Thermodynamics*, containing 11 sections, deals with the Wiener-Khinchine and Nyquist Theorems, Brownian motion, the Fokker-Planck equation, the Onsager reciprocal relations, and the principle of minimum entropy production.

Part 3, *Kinetic Methods and Transport Theory*, consisting of 10 sections, includes the principle of detailed balance, compound nucleus, electrical and thermal conductivity in an electron gas, Kramers-Kronig relations, and Boltzmann's transport equation.

There are four appendices on the method of steepest descent, Dirichlet discontinuous factor, solutions of problems in molecular dynamics using electronic computers, and the virial theorem.

Despite the wide scope of the topics and the brevity of the text, the author succeeds remarkably well in his objectives. As pointed out in the preface, a familiarity with thermodynamics and modern atomic physics is assumed on the part of the reader, and the book should be supplemented by liberal readings from other texts in statistical mechanics. The reviewer heartily concurs.

One of the more refreshing features, which other texts might well emulate, is the listing of well-chosen literature references, some as recent as 1958. For example, the section on negative temperatures refers to the Physical Review papers of Purcell and Pound (1951), Ramsey (1956), Klein (1956), and Abragam and Proctor (1957, 1958). Electronics engineers will find of particular interest all of Part 2 and the various sections dealing with solid state physics.

Two minor corrections: on p. 48, line 3, reference should be to equation (3.15), not to (3.18); on p. 133, the correct title of the book by Lawson and Uhlenbeck is "Threshold Signals."

Coil Winding (2nd Edition)

William Querfurth; George Stevens Manufacturing Co., Inc., Chicago; 192 pp; \$5.00 (U.S.A.)

This is the second edition of *Coil Winding* which was first published in 1954. It is said to be the only book in the field solely devoted to the techniques of coil winding and it draws on the years of experience of one of the largest designers and builders of coil winding machines. In this edition much has been added to the text. New techniques and new machines have been included. The chapters on the complex universal windings were almost completely reworked. The alignment charts for universal coils have been enlarged by the addition of over 2,700 compound gear ratios. In addition, two new chapters have been added to cover toroid, deflection yoke and motor armature winding. This book is of value to the designer as well as the production and set-up man, because it describes all the present-day techniques and methods possible on available equipment. It covers single-layer windings, multi-layer windings, universal and progressive universal windings, toroid, yoke and armature windings, complete with formulae, tables, abaci and more than 100 illustrations.

Television Engineering Volume Four

S. W. Amos and D. C. Birkinshaw. (Iliffe & Sons Ltd.) British Book Service (Canada) Ltd., Toronto; 268 pp; \$7.50.

This is the fourth, and final, volume of a comprehensive textbook on the fundamentals of television theory and practice. The series was written by members of the BBC Engineering Division, primarily for instruction of the Corporation's own staff, and is now made available to a wider technical public.

The present volume deals with a wide range of circuit techniques, many of which are applicable to electronics as well as to television engineering.

It covers, for example, such subjects as counters; frequency dividers; d-c restorers and clamps; gamma-control amplifiers; delay lines; fixed and variable equalizers; scanning coils; field and line output stages; shunt-regulated amplifiers and cathode followers.

Some of these subjects, notably delay lines and equalizers, require a mathematical treatment, but wherever possible self-contained derivations have been included in appendices at the ends of the chapters to avoid interruption of the flow of the argument.

Volume 1 deals with fundamental television principles, camera tubes, television optics and electron optics. Vol-

ume 2 describes the fundamental principles of video-frequency amplifiers and examines the factors that limit their performance at the extremes of the pass-band. It also contains a section on the special problems of camera-head amplifiers.

Volume 3 gives the application in television of sinusoidal, rectangular, saw-tooth and parabolic waves and shows the mathematical relationship between them. The main body of the text is devoted to the fundamental principles of the circuits commonly used to generate such signals.

Provided that, where necessary, the differences between British and North American television practice are borne in mind, this series should prove invaluable to those making a serious study of television engineering. The present volume in particular contains much useful information for engineers in other fields of electronics.

Introduction to the Design of Servomechanisms

John L. Bower and Peter M. Schultheiss. John Wiley & Sons, Inc., New York; 510 pp; \$13.

This book deals with topics covered in the servomechanisms program at Yale University during the past ten years. Much of the material has been presented in a one-semester course in the senior year, the remainder being part of a first-year graduate course. The mathematical level throughout is that of the undergraduate course. No previous background is assumed aside from a knowledge of linear circuit theory and some understanding of linear differential equations.

The text emphasizes a basic understanding of stability and feedback system design, both single and multiple-loop. The authors provide a systematic approach to design, dealing with the principle performance requirements, such as harmonic response, time response, error co-efficients and noise response, and giving attention to the common aspects of non-linear operation. An attempt is made to treat the synthesis problem on a basis that permits the specifications on performance, given components, and noise to be handled at the same time.

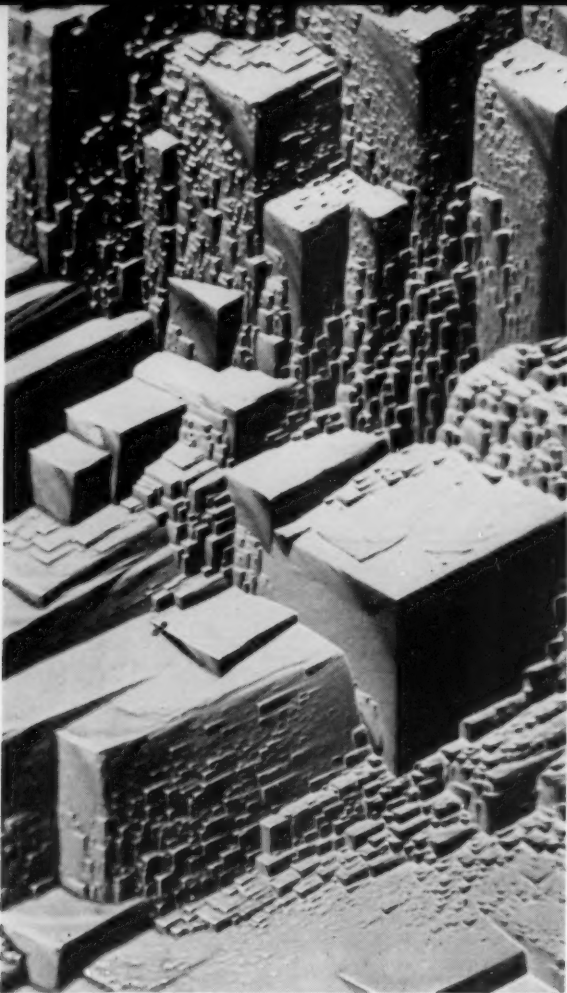
In order to make the volume self-contained, and appendix covering servomechanism components is included which enables the reader to follow examples used in the text and to work representative problems without resorting to outside references.

Handbook of Automation, Computation and Control Volume One

Edited by Eugene M. Grabbe, Simon Ramo and Dean E. Wooldridge. John Wiley & Sons, Inc., New York; 994 pp; \$17.

The present volume, subtitled *Control Fundamentals*, is the first part of a three-volume handbook. Volume 2 deals with computers and data processing, and Volume 3 covers systems and components. Sections have been contributed by a staff of 104 specialists.

(Continued on page 47)



This photomicrograph shows single-crystal antimony with the surface deeply etched for research into the properties of crystals. The varying pattern reflects the variation in density of imperfections. Photo was taken by E. E. Thomas and supplied by the Bell Telephone Laboratories, Inc.



Randle and Boot's original cavity magnetron, developed in 1940, is shown with more modern types in this British official photograph issued by Central Office of Information.

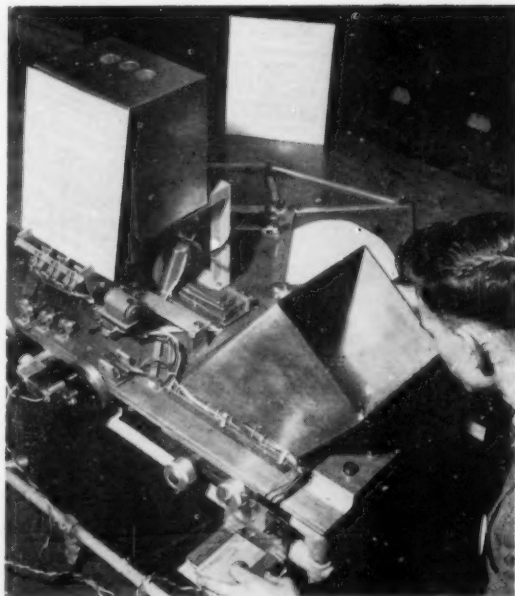
What's new in view

Basic research

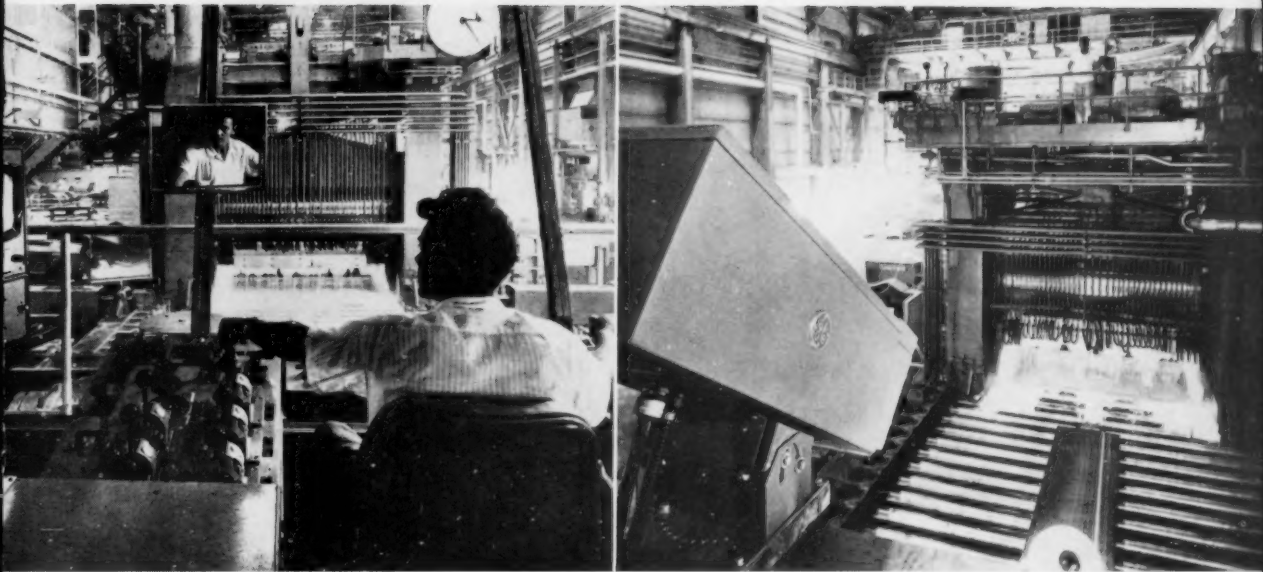
leads the way to

many new processes

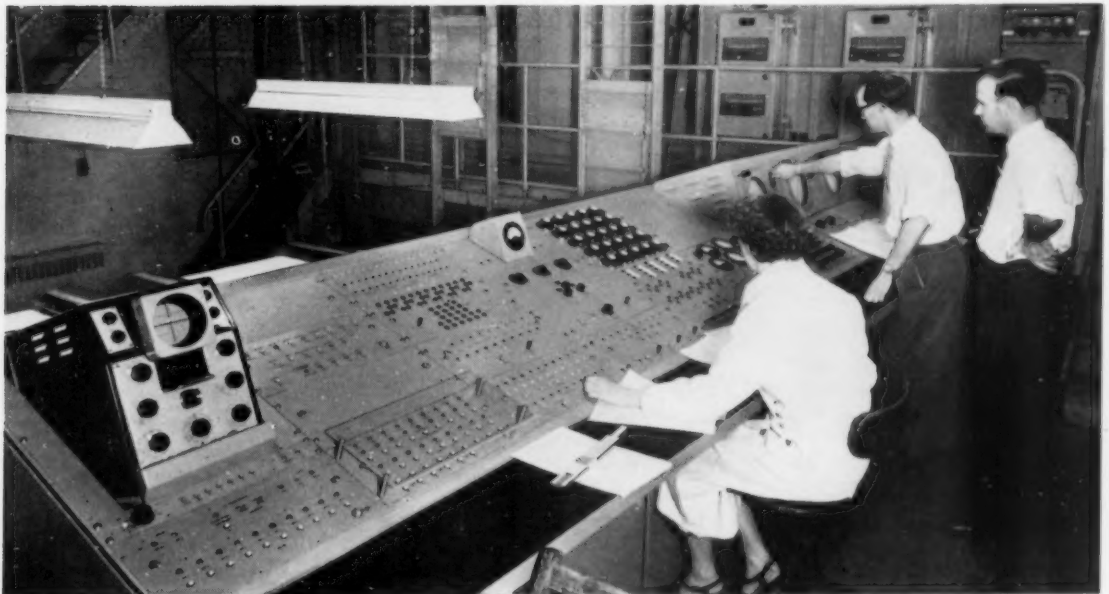
and products



This instrument from Cavendish Laboratory, Cambridge, England, enables lengths, angles and curvatures of nuclear particle tracks to be calculated by computer.



At Kaiser Aluminum & Chemical Corporation's plant in Ravenswood, West Virginia, General Electric closed-circuit television gives the mill operator the vision he needs to control the rolling of white-hot 12,000 pound aluminum ingots. Because operator can see only the near side of mill, he uses tv to view the metal as it is rolled on the far side.



This photo from U.K. Information Service shows the control panel of Tridac (three dimensional computer) which has been installed at the Royal Aircraft Establishment, Farnborough, England. It will be used to help with the design of radar equipment, high speed aircraft and guided missiles. The calculating machine uses approximately 8,000 tubes.

New products

Meter tests the in-circuit operation of transistors

This tester has been designed to check the performance of transistors while they are connected within their circuits. This method of testing is important since it saves trouble-shooting and servicing time. In-circuit measurements are difficult because spurious signals arise from the leakage paths introduced by the circuitry surrounding the transistor under test. Low impedance methods are employed in both the input and output circuits of this instrument to nullify the effects of the external circuitry.

Philco Corp. of Canada Ltd., Don Mills, Ontario. (109)

High frequency transistors

Four new alloy junction silicon pnp transistors are available for operation in the 1 to 4 mc range. Collector voltages have been made sufficiently high to extend use of these transistors to gate circuits, amplifiers, regulators and converters for missiles and controls where higher collector voltage and gain are desired. Input resistance is 35 ohms. Other characteristics include low saturation resistance, high gain, power rating of 150 milliwatts.

The JECC designations for the new transistors are: 2N1024, -25-26 and -27.

Sperry Gyroscope Co. of Canada Ltd., Montreal. (110)

Transistor power supply transformers

Microtran Co. is producing a new line of power supply transformers designed for use with silicon rectifiers. Output current ratings were designed for optimum utilization of the maximum current ratings of commercially available silicon rectifier types. Output voltage ranges were primarily established for powering transistor circuitry. Input voltages are 105/115/125 volts 60 and 400 cps. Supplied hermetically sealed per MIL-T-27A, they are available also on special order in epoxy molded construction.

Douglas Randall (Canada) Ltd., Scarborough, Ont. (111)

TV camera withstands high noise levels

Kin-Tel TV camera model 1986 CN has been designed specifically to resist sound levels that would be injurious to human observers. This permits the camera to be used on rocket and jet engine test stands.

The camera can operate in noise environments up to ± 145 db without an acoustical housing. With a housing it can withstand higher noise levels and has been used in sound levels above 190 db.

Model 1986 CN provides full 600-line resolution. Picture circuits have a band width of 20 cps to 8 mc $\pm \frac{1}{2}$ db. When used with a Kin-Tel camera control unit,



the model 1986 CN automatically adjusts to changing light conditions over a 2000:1 range.

Atlas Instrument Corporation Limited, Toronto. (112)

Weatherproof connectors

A series LR and MR weatherproof connectors have been developed to withstand extreme conditions of mud, ice and water. Used on arctic radar warning systems, they feature clear and black anodic coating for corrosion resistance; built-in rubber gland and gland nut for moisture sealing around the cable; and chain attached caps for sealing off the connector faces when plugs and receptacles are unused. They are machined from bar-stock and are available with standard MS insert arrangements. Coupling threads and sizes comply with MIL-C-5015.

Cannon Electric (Canada) Ltd., Toronto. (113)

Feed-thru filter elements

These low pass, feed-thru filters have been designed for the elimination of high frequency radiation and feed-back in low power circuits in the frequency range from 50 mc to 5,000 mc. The effective capacitance at higher frequencies is greater than indicated by the nominal capacitance as measured at 1 kc. This property provides an increase in equivalent filtering effect of up to 60 db, according to the manufacturer.

Where selective frequency attenuation is desired, as in certain pulse modulation circuitry, units may be supplied with cascaded elements to provide the desired selectivity for individual requirements.

Filters are available in voltage ratings up to 500 vdc at temperatures up to 125 C ambient. The maximum dc and

low-frequency currents are 5 amperes. Standard maximum rf current at rated dc voltage is 0.25 ampere, with higher current ratings available on special order.

Allen-Bradley Canada Ltd., Galt, Ont. (114)

Temperature recorder has multiple range

This five-inch strip chart recorder has a variety of ranges provided by plug-in elements that match appropriate thermocouples. Automatic reference junction compensation eliminates need for external temperature reference. Typical spans are -150 to $+250$ F, 0 to 400 F, 0 to 2,200 F, and many others. Five-inch chart paper with either fahrenheit or centigrade calibrations is available for each range.

Limit of error is 1% of span. A variety of chart speeds is available in 1-, 2- or 4-speed versions. For general purpose use, the basic recorder can be converted to standard potentiometer input by changing the input chassis.

Varian Associates of Canada Ltd., Georgetown, Ont. (115)

Solar cell modules

International Rectifier Corporation is now building silicon solar converter modules that will supply 100 watts per 14 sq. ft. of cell area. These are capable of converting up to 8% of the radiant energy falling on their surface and can be used to provide power for industrial or military applications. Modules with higher rates of conversion efficiency may be obtained on special order.

The modules are assemblies of series and parallel connected silicon solar cells. Each module contains five series connected 1cm x 2cm solar cells embedded in an epoxy mold that provides a rugged,

shockproof, weatherproof housing.

A typical installation can supply a charging current from 25 ma to greater than 1 amp into a 12-volt nickel cadmium battery in bright sunlight. Modules may be interconnected in series-parallel configurations to supply any desired power rating.

Atlas Radio Corp. Ltd., Toronto (116)

Potentiometer for use with motor drive

Starting torque of 1.5 oz. in., running torque of 1.0 oz. in. and stop strength of 550 oz. in. are among the advantages claimed for the Helipot Model A-SP, ten-turn precision potentiometer.

This servo-flange mount version of the Model A was designed for use in gear and motor-driven systems. Mechanical tolerances include: shaft runout .0005 in. tir, register face runout .005 in. tir, shaft radial play .0025 in. and shaft end play .005 in.

Standard resistance range is 25 to 450,000 ohms $\pm 3\%$ with $\pm 0.3\%$ independent linearity ($\pm 0.05\%$ available). Power rating is 5 watts at 40 C ambient, derating to 0 at 80 C.

The non-hygroscopic housing is 2 in. in diameter and 2 3/32 in. in length from the mounting surface. Servo flange diameter is 1.875 in. Weight is 5.5 ounces per section.

R-O-R Associates Ltd., Don Mills, Ont. (117)

Stereophonic preamplifier

The Pilot 216 stereophonic preamplifier provides visual channel balance with two illuminated vu meters and recording



level controls. It has a front-panel lever switch; in one position it measures the tape output level as adjusted by the recording level controls; in the other position the vu meters measure the main audio output level as adjusted by the balance and volume controls. It has 12 inputs for stereo or monophonic signal sources, three of them being high level inputs, and including inputs for a multiplex adapter for fm-fm stereo; five position loudness contour control to provide full-range reproduction at all listening levels.

Frequency response of the Pilot 216 is ± 1 db from 20 to 20,000 cps. Harmonic distortion for 1 volt output is 0.2%. Hum and noise is 80 db below 1 volt. Its sensitivity for 1 volt at the audio output jack is 3 mv for phono, 2.5 mv for tape head, 3 mv for microphone, 110 mv for fm-am, 110 mv for multiplex and 110 mv for tape recorder. Record equalization for RIAA, LP, NAB and AES is provided at calibrated points on the bass and treble tone controls.

NARTB tape equalization is provided with the tone controls in RIAA position, and flat equalization for microphone.

Atlas Radio Corp. Ltd., Toronto. (118)

Signal generator has wide modulation range

The Polarad microwave signal genera-



tor Model PMX covers the frequency range of 4,450 to 11,000 mc by use of two interchangeable plug-in tuning units. Frequency accuracy is rated at $\pm 1\%$. This instrument generates internal pulse, square wave or fm signals — or can be externally modulated. Its range of internal pulse capabilities include 0.2 to 10 usec variable width; 2 to 2,000 usec delay; and 10 to 10,000 pps repetition rate. Pulse rise and delay time is 0.1 usec.

Internal fm generation is a linear sawtooth wave with 5 mc frequency deviation. The instrument is capable of internal, external, pulse or sine wave synchronization. It generates synchronizing pulses of positive or negative polarity, delayed or undelayed.

MEL Sales Ltd., Arnprior, Ont. (119)

Meter probe reaches tight spots

This accessory for Avometers plugs into the end of standard leads for spot checking or for positive connection to hard-to-get-at points in electrical or electronic circuits. The prod tip extends about 1/4 in. beyond the heavy molded plastic housing. Pulling the spring-loaded trigger extends the tip, which opens at the same time to provide a tight-gripping clip.



R. H. Nichols, Ltd., Toronto. (120)

Direct reading flame photometer

The Baird-Atomic direct reading flame photometer has been designed for use in hospital laboratories to determine the concentrations of sodium and potassium in samples of blood and other biological

fluids. Na and K are read directly in Meq/l from a meter on the instrument, eliminating tedious calculations.

The photometer has been designed for microsampling techniques; as little as 0.05 cc of serum diluted 1:200, is needed to run the determinations and then rerun as a check. Both Na and K can be determined directly from the same microsample.

The photometer uses ordinary city or manufactured gas, is portable, has an internal standard and is easily calibrated.

Radionics Ltd., Montreal. (121)

Electronic equipment calibrator

Calibrator Type TC-10 has been designed for precision alignment calibration of electronics equipment such as fm record/reproduced systems. It contains a voltage standard accurate to 0.01%. Working calibration voltages are available in nine steps, each adjustable over a range of 10%. Nine precision



oscillators and seven binary dividers provide 63 accurate calibration frequencies ranging from 1,012 cps to 151.2 kc. These can be introduced into a system for discriminator alignment or for comparison with the output of a voltage controlled oscillator.

The instrument uses semi-conductors throughout, weighs 25 pounds and is housed in a fibre glass case.

Ampex American Corp., Ottawa. (122)

Solid state batteries

Dynox solid state batteries come in four different sizes; No. 95 has a 95-volt potential in 0.14 cubic inches; No. 190 has a 190-volt potential in 1.15 cubic inches; No. 380 has a 380-volt potential in 1.57 cubic inches; No. 950 has a 950-volt potential in 2.87 cubic inches.

These batteries are manufactured by the Patterson, Moos Div. of Universal Winding Co.

Lake Engineering Co. Ltd., Scarborough, Ont. (123)

(Continued on page 46)

Air jet cools lens of tv camera for viewing in hot areas

This closed circuit television system has been designed for operation in temperatures exceeding 2,000 F. It utilizes an air-cooled lens that allows remote viewing of boiler flames or hot areas without danger of the lens melting.

The lens is mounted in a 14-inch steel tube. Compressed air is blown through peep holes in the lens housing and across the face of the lens.

Designed primarily for large industries and utilities, the system requires only 15 cfm of air for cooling. The lens angle of view is better than 40 degrees and it is interchangeable with other existing lenses.



Canadian General Electric Co. Ltd., Toronto. (124)

Low level 60 cps magnetic amplifiers

Airpax Preac amplifiers are rated for operation from 60 ± 6 cps power lines at 115 ± 11 rms volts. Power drawn is less than 1.5 watts. These amplifiers accept dc polarity reversible input signals and deliver unfiltered dc polarity reversible outputs.

Each of the four types available can be used by itself or as a pre-amplifier for such data sensing devices as thermocouples, strain gauges, bolometers, as well as for high-impedance dc sources. They provide a power gain greater than 50db and a full linear output of 2 volts into a 5,000-ohm load with null drifts as low as 0.03 microamperes, 2.25×10^{-12} watts, referred to the input.

Leonard Electric Ltd., Toronto. (125)

Power ferrite for low frequencies

Power ferrite R-03 has an almost perfectly rectangular hysteresis loop that provides high efficiency operation in the frequency range from 400 cps to 15,000 cps.

The magnetic properties of the R-03 ferrite are: saturation induction at 10 oersted, 3900 gauss; remanence induction, 3360 gauss; coercive force, 0.37 oersted; maximum differential permeability, 40,000 with dc test current in all

cases. At 1500 cps the initial permeability is 325, and the maximum permeability is 3500. The switching time for this square loop ferrite is 2.9 usec at 2.5 Hc, and the Curie temperature is 315 C.

Allen-Bradley Canada Ltd., Galt, Ont. (126)

Ice detection system test set

Ice detector test set, type T272, Mk 2 is used for testing the ice-detection system installed in an aircraft or on the bench. When used for installation tests, it can detect faults in the associated aircraft electrical wiring in addition to its normal function.

Basically, the test set provides a controlled source of vacuum or pressure which can be applied to the ice detector on test, to simulate the pressure changes which occur within the unit when icing conditions are encountered.

Interpretation of the function of the ice detection system is performed by connecting a multimeter to the ice detector signal pin and ground. By noting the readings on the vacuum gauge when the icing signal appears, the serviceability of the system may be established.

Canadian Applied Research Limited, Toronto. (127)

Radar echo enhancer

The Sperry echo enhancer (SEE) is used to enlarge the echoes on ground radar. Mounted within an aircraft or target drone, the equipment detects pulses from ground radar and sends back signals of greater intensity to create pips of any desired size on the ground radar scopes.

It consists of a traveling wave tube, miniaturized power package and antenna, weighing less than 20 lb total.

The SEE equipment is designed for broad use with either surveillance, air-intercept or tracking radars. It can be applied, also, to enable ground controllers to locate and identify aircraft with much greater certainty and at greater distances.

Sperry Gyroscope Company of Canada, Ltd., Montreal. (128)

Firewall connector resists moisture

The series "KE" connectors have been designed to combat a major problem in the airplane industry—moisture accumulation in firewall electrical connectors and the resultant reduction in voltage rating.

In addition to meeting the 2000 F flame test specified in MIL-C-5015, this new connector will stand up under continuous operation at 400 F. Moisture proofing is achieved with seals made of a fluorinated silicone which has improved

the resistance to oil and skydrol hydraulic fluid.

Series "KE" connectors are produced in two basic shell styles, for conduit use and wire bundles. A variety of shell sizes and insert arrangements are currently available, and most sizes are furnished in both long and short versions.

Cannon Electric (Canada) Limited, Toronto. (129)



Height-slant control Leroy scriber

Leroy scriber No. 3237-12 can be adjusted to form template characters of varying heights and slant angles without changing character width. It can form characters either vertical or slanting at any angle up to 45 degrees forward, and any height from 60% to 150% of the size of the figures represented on the drawing template used. It will accept pens from 0000 to 8 and can be used with templates up to size 500C.

Keuffel & Esser Co., Hoboken, N.J. (130)



Marker prints on radio parts

The Anderpress foot-operated production marker will print on metal, plastic, wood, carbons, etc. It will mark on flat, curved or irregular surfaces.

The marker uses rubber dies, rubber type, brass dies or brass type, also rubber or metal logotypes. It has a printing coverage area of $2\frac{1}{2}$ in. by $5\frac{1}{2}$ in.

Anderson-Stanley Stamp Co., Chicago. (131)

(Continued on page 51)

People in the industry — continued

Appointments at Standard Coil Products

G. J. Van Buskirk, C.G.A., has been appointed general manager of Standard Coil Products (Canada) Ltd. Mr. Van Buskirk, whose previous background includes public, financial, and industrial accounting and management, joined the company as comptroller in July, 1955, a position he will retain. He is a graduate in



Van Buskirk



Hedemark



Manicki



Peterson

business administration and holds the degree of Certified General Accountant.

Frank A. Hedemark has been appointed sales manager. His service with the company is more than 11 years, four of which were spent in Canada. After assisting in the organization of the company's production facilities, he took over the duties of customer acceptance manager and sales engineer. Mr. Hedemark's association with the electronics industry dates back to 1927, the first 20 years being spent with Stewart Warner Corporation.

Gert L. Manicki has been appointed chief engineer. He has been associated with the Canadian radio and television industry since he came to Canada from Germany in 1951. He joined the company as project engineer in August, 1956.

C. W. Peterson who has been associated with Standard Coil Products for the past 15 years, has left to join Romar Plastics Inc. of St. Charles, Ill.

Mr. Peterson pioneered the Standard Tuner in Canada back in 1948. He moved to Toronto in June, 1955, to assume the position of sales manager for the Canadian operation. Mr. Peterson has been appointed general sales manager of Romar Plastics for U. S. and Canada, so he will still be in contact with the many friends he has made in Canada.

Ontario sales engineer

Radionics Limited announces the appointment of **William A. (Bill) Wood** to direct the marketing for

Central and Western Ontario of the company's range of electronics, microwave, high vacuum and nuclear instrumentation.

Mr. Wood is a graduate of the University of Toronto. Since 1950 he had been associated with Ontario Hydro as an electrical application engineer. Previous to this he served in quality control, production and test equipment engineering capacities with Canadian

Arsenals Ltd., and Research Enterprises.

Mr. Wood will make his headquarters at the newly established Toronto branch office of Radionics at 65 Brinloor Blvd., Scarborough, Ontario (AMherst 1-0936).

Executive engineer

E. E. Fitzgibbons, president of Trans Canada Telemeter Ltd., has announced the appointment of **A. G. Day, P.Eng.**, as executive engineer for the company. Mr. Day is a graduate of the University of Toronto, electrical engineering, and has had 15 years' experience in communications, broadcast, tv and radio receiver design, production and inspection. Until recently he was chief engineer of station CKCO-TV, Kitchener, Ont.

Will manage design of supervisory control

H. J. Davie, president and general manager of R. H. Nichols Ltd., Toronto, has announced the appointment of **A. S. Thomson** to the position of manager, supervisory control design.



Thomson

During the past 10 years he has been engaged in this type of design work with the company.

Library — continued

Written and edited with an emphasis on systems engineering, the handbook covers material of direct use to all levels of technical personnel in the associated fields of automatic control and computers.

The major objective is to provide practical design data for research, development and design in feedback control, computers, data processing, control components, and control systems. The stress throughout is on new techniques and components for designing and developing control systems.

Volume I covers aspects of mathematics not usually available in engineering handbooks, such as sets and relations, Boolean algebra, probability, and statistics. It includes a compilation of numerical analysis methods; the latest techniques and comparisons of different methods of digital computation; self-contained treatments of feedback control theory and of operations research; and material on information theory and transmission.

Referring to the Handbook as a whole, **Gordon C. Brown** of M.I.T. says in his preface: "It truly represents today's optimum package of that body of knowledge that will be negotiable at par by technologists for many years to come in a wide range of disciplines."

Catalogues and brochures from the manufacturers

Wall chart lists American receiving tube replacements for European manufactured types. The Sylvania Electric Products Inc. chart lists over 250 tubes. Hackbusch Electronics Ltd., Toronto. (101)

Research newsletter. Single-page circular issued every two months will contain news of services available from the Ontario Research Foundation, Toronto. (102)

Instrument Engineer. Journal devoted to measurement and automatic control in industry, published by George Kent Ltd., England. Direct subscription enquiries to George Kent (Canada) Ltd., Toronto. (103)

Analysis of technical writing by engineers. Six page report analyses activity of engineers in writing articles and papers. Harry W. Smith Inc., New York. (104)

Panel electrical measuring instruments. Brochure covers ac and dc voltmeters, ammeters and wattmeters. Canadian Research Institute, Toronto. (105)

Magnetic shielding manual 101-122, shows ways to use netic and co-netic shielding; 31 pages. Magnetic Shield Div., Perfection Mica Co., Chicago. (106)

The contact modulator. Part 1: why use choppers. This 23 page booklet is first of series on choppers. Airpax Products Co., Fort Lauderdale, Florida. (107)

Key telephone system No. 1A1. Sales letter SL-5821 provides descriptions, engineering data and wiring diagrams of installations. Northern Electric Co. Ltd., Montreal. (108)

Canadian Westinghouse will market educational reactors

Canadian Westinghouse has announced it will market a complete line of research, training and educational nuclear reactors manufactured by Aerojet-General Nucleonics of San Ramon, California.

J. A. Campanaro, vice-president, project development group, reported a distributor agreement has been signed covering all six of Aerojet-General's reactor models — from the smallest "subcritical" unit to a large material testing unit with 10,000 kilowatts thermal output.

The reactor will be sold to universities and medical and industrial research centres. Aerojet will assist in training customer personnel to operate the units.

"Westinghouse will continue to concentrate on atomic power reactor and nuclear propulsion research," Mr. Campanaro said. "But we recognize the importance of non-power units in research work and in educating future scientists, physicists and engineers in atomic techniques."

The line of Aerojet reactors, he said, is adapted to the educational needs of countries where training facilities must keep pace with the latest technological developments. With the exception of the large testing reactor, all models can be located in existing laboratory space if desired.

Larger models in the line are de-

signed for advanced research work and production of large amounts of radioisotopes for medical and industrial purposes.

Smaller reactors in the series include the subcritical unit that does not sustain a chain reaction, and a portable model that can be used for industrial research and production of short-lived radioisotopes. These smaller reactors require no special electrical distribution facilities to operate the instruments and motor drives. They can, in effect, be "plugged" into the nearest outlet, Mr. Campanaro explained.

Five scientific meetings planned on atomic energy

Five scientific meetings on various aspects of the peaceful uses of atomic energy will be held by the International Atomic Energy Agency (IAEA) during 1959, the Director General of the Agency, Sterling Cole, announced recently. Other international organizations are expected to collaborate.

The first conference will be a three-day seminar in Vienna, beginning on February 25, on the scanning of medical radioisotopes, at which 45 experts will discuss the latest techniques for determining the distribution of radioisotopes in the human body.

In July there will be a seminar at Saclay, France, on training scientists

in the peaceful uses of atomic energy. About 80 experts are expected to attend.

A six-day conference in Warsaw on the application of large radiation sources in industry, especially chemical processes, is scheduled for September, with 300 delegates expected to attend.

The standardization of radioisotopes will be discussed at a symposium on radioactive metrology, the science of weights and measures, to be held in Vienna in October.

Finally, a conference will be held in Monaco in November on the subject of radioactive waste disposal.

U. S. firm exports tandem Van de Graaffs

The sale of two 10-million electron volt tandem particle accelerators to Switzerland and Australia—which will mark the first overseas shipment of these very large machines—was announced recently by High Voltage Engineering Corporation.

The million-dollar Van de Graaff machines now under construction are both scheduled for delivery in 1960. One of the machines, consigned to the Swiss Federal Institute of Technology at Zurich, will be installed at the "Kernphysik I" laboratory, about four miles from downtown Zurich. The huge positive ion accelerator will be used for basic nuclear research in reactions produced by charged particles and fast neutrons. The Swiss government-supported program will be headed by Professor Dr. Pierre E. Marmier of the physics department of the Swiss institute.

The other 10-Mev machine will go



These pictures show some of the research work being done at the General Electric Research Laboratory, Schenectady. Dr. Karl B. Persson (above) examines equipment used for measuring ion cyclotron resonance as part of his work on new techniques for determining the electrical conductivity of plasmas. Dr. W. F. Westendorp (extreme left) and Dr. H. Hurwitz check installation of capacitor bank used to provide energy for their research in atomic fusion.

to the Australian National University at Canberra and will be used in experiments with hydrogen and deuterium bombardment of light and heavy elements. Professor Ernest W. Titterton, head of the nuclear physics department of the Australian National University, reported the purchase of the tandem accelerator. Construction of a new building to house it was made possible through appropriation of special funds by the Australian government.

New markets for electronics

With the progress that is being made in the commercial applications of atomic energy we can expect to see an increase in markets for specialized electronic control equipment.

The general trend can be seen from recent contracts placed in the United States. Consolidated Controls Corp. has received contracts totaling approximately \$600,000 from the United States Atomic Energy Commission and the General Electric Co. for design and manufacture of primary plant instrumentation for the first nuclear powered U.S. Navy destroyer.

Earlier, Consolidated Controls announced the receipt of an order exceeding \$800,000 from the Westinghouse Electric Corp. covering instrumentation for an undisclosed number of atomic submarines.

Nuclear Instrumentation Association

Establishment of the Nuclear Instrumentation Association has been jointly announced by a group of American nuclear instrument manufacturers. Announcement of the organization stated that creation resulted from the increased importance of nucleonics and nuclear instrumentation within the field of electronics.

Named chairman of the new group at a recent organizational meeting in New York City was Nicholas Anton, President of Anton Electronics Laboratories, Brooklyn, New York.

Regional vice-chairmen named to serve during an initial period are H. G. Ayers, general sales manager of BJ Electronics, Borg-Warner Corp., Santa Ana, Calif.; Potter Trainer, manager of atomic instrument sales at Baird-Atomic, Cambridge, Mass.; Frank Atlee, Jr., RCA Services Co., Camden, N.J.; C. E. Delker, Bendix Aviation Corp., Cincinnati, Ohio; and D. D. Pearson, commercial sales manager of Nuclear Electronics, Inc., Philadelphia, Pa.

Purpose of the Nuclear Instrumentation Association is to give industry support to research, development and production in the U. S.

Versatile Research Accelerator

3-Mev Model K Van de Graaff®

Photos Courtesy of Gulf Research and Development Company

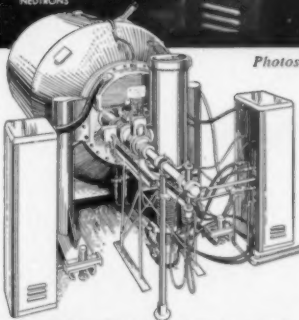
This powerful multi-particle accelerator — proved in the field — is the basic tool for a broad program of fundamental or applied radiation research.

Now in use for: nuclear physics, radiation processing, polymerization, radiation chemistry, reactor engineering, sterilization, radiation damage, biology, particle injection, radiography.

ELECTRONS: 1 microamp to 1 milliamp.
X-RAYS: 900 R per minute at one meter. (Equivalent to 20,000 curies of Co-60).

POSITIVE IONS: 10 to 200 microamp.

NEUTRONS: 6×10^{11} neutrons per amp. Voltage and current output are stable, precisely controlled, and continuously variable.



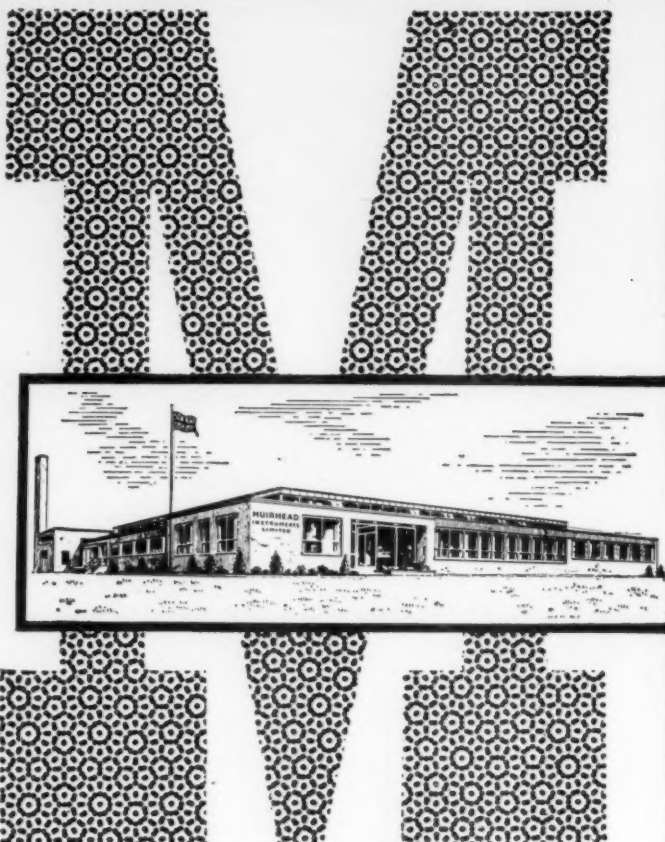
The 3-Mev, Model K Van de Graaff can be furnished for horizontal installation as illustrated above.

Write our Technical Sales Department for more information on the Model K, 3-Mev Van de Graaff.

HIGH VOLTAGE ENGINEERING

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Defence contracts

Unclassified electronics contracts for \$10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parenthesis indicates the number of contracts, the amount being the total value.

November 16-30, 1958

Amalgamated Electric Corp. Ltd., Ottawa, telephone cable, \$50,703.
Bell Telephone Co. of Canada, Ottawa, technical services, \$38,560.
Canadian Admiral Corp. Ltd., Port Credit, Ont., equipment, \$94,824 (2).
Canadian General Electric Co. Ltd., Toronto, equipment, \$24,079.
Canadian Marconi Co., Montreal, signal generators, \$43,516.
Canadian Westinghouse Co. Ltd., Ottawa, terminals of mobile tropospheric scatter equipment, \$719,773.
Delta Aircraft Equipment Co., Toronto, equipment, \$30,545.
Instronics Ltd., Stittsville, Ont., equipment, \$33,266.
Lackie Brothers Ltd., Waterloo, Ont., erection of antenna, \$30,198.
Standard Telephones & Cables, Mfg. Co. (Canada) Ltd., Montreal, installation of communication equipment, \$14,280.
TMC (Canada) Ltd., Ottawa, equipment, \$31,815.

December 1-15, 1958

Ahearn & Soper Co. Ltd., Ottawa, antennae, \$16,910.
Ampex American Corp., Ottawa, recorders and accessories, \$130,632.
Aviation Electric Ltd., Montreal, technical services, \$10,000; spares for aircraft instruments, \$26,531.
Canadian Admiral Corp. Ltd., Port Credit, Ont., test equipment, \$39,887.
Canadian Aviation Electronics Ltd., Montreal, spares for flight simulators, \$10,128.
Computing Devices of Canada Ltd., Ottawa, aircraft navigational equipment, \$50,924.
E. P. Electric Products Co. Ltd., Montreal, installation of telecommunication cable extension, \$13,993.
Ferranti-Packard Electric Ltd., Toronto, modification of aircraft instruments, \$28,344.
Marsland Engineering Ltd., Kitchener, Ont., tech. services, \$10,000.
Northern Electric Co. Ltd., Ottawa, telephone cable, \$50,214 (2).
Philips Electronics Industries Ltd., Toronto, equipment, \$15,293.
Sperry Gyroscope Co. of Canada Ltd., Montreal, maintenance and spares for radar equipment, \$395,000.

Stark Electronic Instruments Ltd., Ajax, Ont., signal generators, \$61,-002 (2).

TMC (Canada) Ltd., Ottawa, communication equipment, \$150,489.

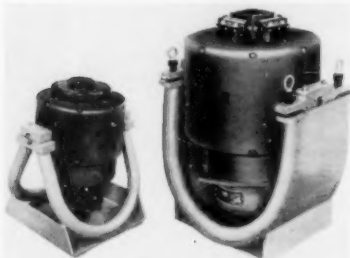
W. Gary Wright Electronics of Canada Ltd., Whitby, Ont., radio crystals, \$10,000.

New products—cont.

Electrodynamic shakers

Two wide-band electrodynamic shakers have been designed for elimination of all secondary structural resonances, so that the armatures behave as simple single degree of freedom systems over an extended frequency range. The shakers are model 219, rated at 500 pounds force output, and model 227, rated at 150 pounds force output.

The model 219 has a 7.5 pound armature of extruded, webbed aluminum construction. The armature allows a high first bare table resonance of 6,000 cps, or 4,000 cps with a 14-pound load.



The model 227 has a 1.75 pound armature and maintains a first bare table resonance of more than 9,000 cps, or 7,000 cps with a 1.81 pound load, and 6,000 cps with a load of 3.44 pounds.

Model 219 is 29% in. high, 24 in. wide and 18 in. deep. It weighs approximately 1,025 pounds. The model 227 is 21½ in. x 16 in. x 18¼ in., and weighs 350 pounds.

Ling Electronics, Inc., Culver City, California. (132)

Variable transformers

Variable transformer Model VT4 is rated at 3.5 amps and Model VT8 is rated at 7.5 amps. They are interchangeable mechanically and electrically with comparable units of other popular manufacturers. Table or panel mounting is possible due to an adjustable shaft. Dials are direct reading, calibrated on one side for overvoltages connection and on the other for normal line connection.

Ohmite Manufacturing Company, Skokie, Ill. (133)

(Continued on page 52)

Compatible Automatic CENTRAL OFFICE TERMINAL EQUIPMENT for RADIO TELEPHONE SERVICE

NOW SECODE SIGNALING "BRIDGES THE GAP" BETWEEN WIRE AND WAVE

New Secode equipment solves the problem of extending subscriber service. By interconnecting radio and land line exchanges, complete telephone service is provided for mobile and remote rural users.

Central office terminals and associated equipment for interconnection between mobile radio circuits and either manual or automatic dial telephone exchanges are now in production. Secode equipment is fully compatible with Bell and Independent telephone practice. It is flexible, low cost, and simple to install.

Advantages of New Secode Dial Signaling Systems

Operates from standard telephone dial • Fully compatible with existing radio-telephone-standards • Telephone quality engineering for ultimate reliability • Individual mobile identification for automatic ticketing • Unlimited number of mobiles per radio channel • Ample call code capacity for nationwide numbering and roving service • No special instruction needed, mobile telephone operation simulates standard land line practice • Only the called mobile can answer a call • Only the calling mobile can seize and release a line • Full channel access for emergency communication • Conelrad control available • Repetitive ringing at the mobile • Superior fringe area operation • No FCC waivers required.

**SEND FOR
FREE
BOOKLET**

An informative eight-page booklet titled, "Selective Signaling Equipment for Mobile Radio Systems" is yours for the asking. For your free copy along with the name of your nearest Secode engineering representative who will be happy to answer your questions, please address Dept. 772.



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For further information mark No. 38 on our Readers' Service Card

New products—continued

Transfer function analyser tests control systems

The Muirhead transfer function analyser can be used to carry out frequency response tests of automatic control systems. The equipment comprises: model D-880-A two-phase, low-frequency decade oscillator for exciting the system sinusoidally; model D-729-B low-frequency phase-meter for measuring phase and amplitude differences between two signals; model D-925-A tunable filter for use with the phasemeter when output signals from the system under test are distorted.

The combined equipment has a frequency range of 0.5 cps to 10 kc and can deal with phase differences from 0 deg to 360 deg, amplitude differences up to 70 db, and harmonic distortion up to 100%.

Muirhead Instruments Limited, Stratford, Ont. (134)

Nylon headed screws

The process of insert molding has been put to use to develop products for the electronics industry. One such line consists of steel screws with nylon heads molded on. Such screws allow the designer to make use of the structural

strength of steel and the insulating properties of nylon without dealing in separate insulators or insulating assemblies. These and other nylon products — screws, hex nuts, chain sprockets, rivets — have just been introduced by Gries Reproducer Corp.



Paisley Products of Canada Ltd., Toronto. (135)

Automatic television program controller

This automatic television program controller is capable of standard type operation using the international five-hole card. It automatically carries out operations which normally are performed

manually on the master control panel and will accept previously prepared instructions of those operations and their timing. A full 24 hour programming is stored by the equipment, timing being accurate to one second, with each instruction or group of instructions pre-coded by the time.

The controller is capable of giving 169 different instructions with a basic capacity of 50 instructions being provided. Further groups of circuits can be added to increase this capacity to the maximum.

Facilities are provided for the production of a sequence of operations not exceeding ten minutes in duration at any period during the 24 hours, covering any abnormal requirement. Another facility allows the whole program to be retarded or run in advance of its scheduled timing.

Pye Canada Limited, Ajax, Ont. (136)

Silicone rubber vulcanizes at room temperature

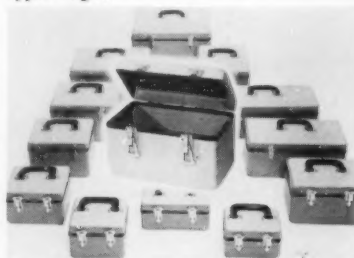
Silastic RV 502 silicone rubber vulcanizes in only 30 minutes at room temperature. It offers a fast, simple, low-cost method of obtaining rubber-like properties.

Silastic RV 502 retains flexibility from minus 70 to plus 500 F, has good electrical insulating properties, resists weathering, moisture, ozone and corona. It is suitable for sealing and caulking metal-to-metal and metal-to-rubber joints; potting and encapsulating electrical and electronic parts; as a mold of impression material for making prototype parts; as a shock and vibration absorber for delicate components.

Dow Corning Silicones Limited, Downsview, Ont. (137)

Aluminum carrying cases

The new line of Zero commercial carrying cases is designed to meet the needs of manufacturers whose products require dust-tight and spray-tight protection at reasonable cost. These are stock items and range in size from 4 in. x 7 in. x 4 1/4 in. high to 9 3/16 in. x 13 1/4 in. x 9 in. high. They are made of .063 deep drawn aluminum and meet specifications MIL STD 108C paragraphs 3.7 and 3.21. They are equipped with a Neoprene gasket, nickel-plated latches and aircraft-type hinges.



They are available unpainted or finished in light grey "Perma-Resin" multi-polymer coating.

Zero Manufacturing Co., Burbank, Calif. (138)

(Continued on page 53)

Soldering is EASIER FASTER BETTER with American Beauty Soldering Tools

American Beauty electric soldering irons are the highest quality made. The finest engineering, best materials and on-the-job experience since 1894 is yours with every American Beauty. There is a right model, correct tip size and proper watt input to do any soldering job easier, faster and better.

TEMPERATURE REGULATING STANDS

Automatic devices for controlling tip temperatures while iron is at rest—prevents overheating of iron, eliminates frequent retinning of tip, while maintaining any desired temperature. Available with perforated steel guard to protect user's hand.



201-B

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3/4" TIP
60 WATTS



NO. 3130
7/8" TIP
100 WATTS



NO. 3150
1" TIP
200 WATTS



NO. 3170
1 1/4" TIP
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NO. 3190
1 3/4" TIP
550 WATTS



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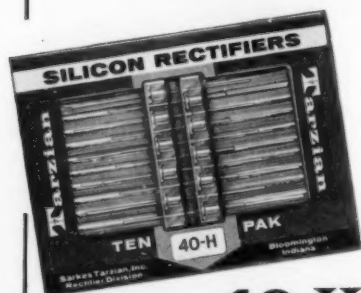
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F-4

Lowest priced 750 mil. silicon rectifier available . . . Ten in a handy pack—rated at 0.75 amps. dc, 400 P.I.V. . . . For use in radio, television and electronics.



40-H

Industry standard top hat hermetically sealed silicon rectifier rated at 0.75 amps. dc, 400 P.I.V.

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TEL. ROGER 2-7535

EXPORT: AD AURIEMA, INC., NEW YORK CITY

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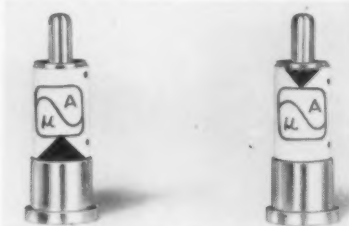
New products — cont.

Varactor diodes

Microwave Associates silicon varactors are available now in production quantities. The varactor is a diffused silicon pn junction diode designed to be a variable capacitance with low loss at high frequencies. The unit complies with MIL-E-1 outline 7-1 for cartridge type crystal rectifiers and will fit most standard crystal holders.

In the standard MA-460 series, the pin end of the diode is connected to p-type material on the top of a small "mesa" and the n-side of the silicon element is connected to the base. The reversed polarity unit denoted by the suffix R is also available.

The mechanically reversible MA-450 series may also be ordered with longer delivery time but the single-ended units are generally recommended because they ensure placement in holders with the proper end in contact with a heat sink.



The minimum cut-off frequencies are graded in 10 kmc steps starting with the suffix A at 20 kmc. Units are currently available as high as 60 kmc. The varactor has been designed for use in such instruments as low-noise diode amplifiers, harmonic generators, frequency dividers, etc.

E. G. Lomas, Ottawa.

(139)

Vernier variable resistor

This vernier variable resistor with ball bearing rotation has been designed for fine tuning applications. The contact arm rotates only one deg for each 13.5 deg shaft rotation. Total contact arm rotation is 300 deg ± 5 deg and total shaft rotation approximately 4,000 deg.

Type VA-45 is a 15/16-in. diameter, 1/4 to 1/2-watt variable composition resistor with only 5/32 in. more depth than standard non-vernier type 45. Resistance range is 250 ohms through 10 megohms (linear taper) with standard tolerance $\pm 30\%$ for 250 ohms through 5 megohms and $\pm 40\%$ for 5 to 10 megohms. Voltage rating across end terminals is 500 vdc and voltage rating bushing to terminal 1,000 vac for one minute high pot test with 750 vdc operating maximum.

C. C. Meredith & Company Ltd., Streetsville, Ont.

(140)

(Continued on page 54)

INDUCTROL* Voltage Regulators

Drift-free, Distortion-free,
Stepless Voltage Regulation



FEATURES: No brushes to wear out! No tubes to replace! No routine maintenance! High efficiency and short-circuit strength!

The General Electric Inductrol voltage regulator can be used to hold a constant load voltage accurately when supplied from a fluctuating supply, or can provide a variable load voltage from a relatively constant supply. Either of these functions can be automatically controlled, or can be manually controlled by means of motor drive or hand crank.

Other Inductrol regulator controls can be furnished to hold a constant current or voltage, either a-c or rectified a-c. Inductrol regulators of dry-type construction are available for circuits up to 600 volts. Liquid-filled Inductrol regulators are available from 2400 to 13,800 volts.

For further information, call your local C-G-E Sales Office, or write: Section 425-17, Apparatus Department, Canadian General Electric Co., Ltd., PO Box 601, Guelph, Ontario.

*Trademark

AAD-9204-53901

Progress Is Our Most Important Product

GENERAL ELECTRIC

For further information mark No. 53

New products—cont.

Dual pentode audio tube

The Sylvania tube type 6DY7 is a dual pentode designed for output stage use in audio amplifiers. It utilizes the Framelok grid construction.

The tube incorporates two identical pentodes in one envelope. When operated class AB push-pull between its own pentode sections at 250 volt conditions, type 6DY7 is capable of delivering 11 watts of output at 2.5% total harmonic distortion. At 400 volt conditions, the tube will deliver 20 watts of output at 2% distortion. When operated class A

one section can deliver 5 watts output at 9% distortion.

Hackbusch Electronics Ltd., Toronto.
(141)

Interchangeable matched thermistors

More than 30 new units are classified in five major groups, each representing a specific type of matching in these interchangeable and close tolerance matched thermistors. The five major groups are resistance matching, voltage matching, series-parallel matching, resistance temperature matching, resistance ratio-temperature matching.

For example, in the resistance-tem-

perature matching of two or more thermistors, all are matched to a specific resistance-temperature curve within a fixed tolerance and over a specified temperature range. Full specifications and descriptions of all the interchangeable matched thermistors may be obtained from the manufacturer.

Victory Engineering Corp., Union, New Jersey.
(142)

AVAILABLE

DO YOU REQUIRE a young, energetic man on your Electronic team—A man with several years of experience in the Communication Mast and Tower field—Experienced in Installation Design Analysis—Sales—Administration. Please address replies to: Box 25, Canadian Electronics Engineering, P.O. Box 100, Toronto.

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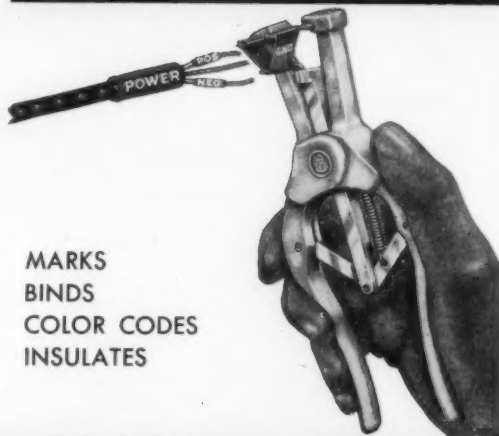


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ANOTHER PRODUCT OF CANADIAN INGENUITY:

A truly dependable source of 20 c/s ringing current.

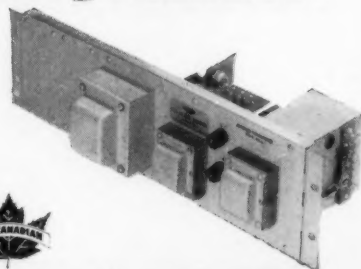
- Independent of A.C. mains.
- No maintenance.
- Accurate frequency for signalling.
- 20 watt capacity.



PYLON ELECTRONIC DEVELOPMENT company, Ltd.

Communications Systems and Equipment

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PYLON RINGING GENERATOR
TYPE RG-1

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We ended
chemical
dangers
and
increased
production
**WHEN
WE...**



STOPPED making our own etchant and **STARTED** using **HUNT S.C.E.**

"We made our own etchant for plated circuit boards until we heard about HUNT S.C.E. Solution.

"It took time to mix up large quantities of chromic and sulphuric acid into an etching solution which gave off noxious fumes and was dangerous to handle. It varied from batch to batch and had to be heated to 140° F. to etch properly.

"So we did the wise thing... stopped mixing our own solutions and switched to Hunt S.C.E. ... No more chemical dangers and we're saving money too... we etch at a uniform rate around the clock. HUNT S.C.E. (Solder Circuit Etch) is best for your plant too because it:

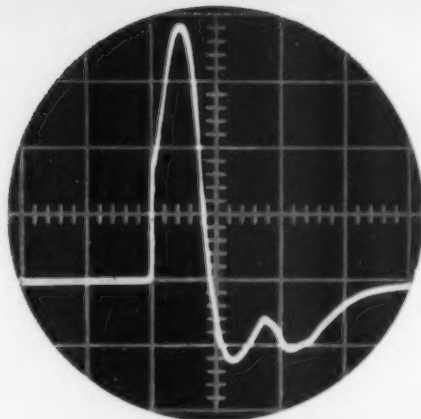
1. Etches rapidly at room temperature.
2. Has high capacity for copper.
3. Never attacks the solder-plated circuit.
4. Gives fast, odorless etching of copper.
5. Produces boards that pass all corrosion and stability tests.
6. Is a prepared solution with guaranteed uniformity and rigid laboratory control.



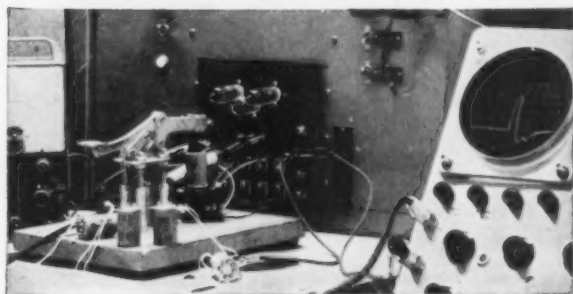
For detailed information about HUNT S.C.E. and valuable production handling information, write for Technical Bulletin No. 3 — "The Etching of Solder Plated Circuit Boards by Hunt S.C.E. Solution."

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CANADIAN ELECTRONICS ENGINEERING FEBRUARY 1959



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Test jig duplicating actual conditions the transformer will meet in service.

Strict conformation to mechanical and electrical specification is ensured by 100% inspection.

Each Hammond Transformer is individually tested under working conditions in a duplicate of the circuit in which it will be used.

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are available
on request!**



1. 0.65 μ Sec.
2. 0.6 μ Sec.
3. 0.5 to 2 μ Sec.

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|---------|--|
| 4650 | 3 Phase Special Open Frame Transformers |
| 5023 | JCNAAF-T-19, MIL-T-27A |
| 5057 | Saturable Core Reactors |
| 5060 | Consoles |
| 5100 | Variable Condensers |
| 5106 | Miniature Transistor Mounting Dimensions |
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Cambion® Miniature Jacks and Plugs

Ideal for
computer patchwork panels



Take your pick from the large selection of CAMBION miniature jacks and plugs. Varying widely in types, these top quality, precision made units are ideal for quick, tight, space-saving patchwork on panel boards.

The jacks make perfect electrical connections, thanks to their special beryllium copper compression springs, floating D keys and solid fronts. Jacks are available in shank lengths for varying panel thicknesses. Pin diameters of the plugs are .080", .062" and .045".

For full information, write Cambridge Thermionic of Canada Limited, 2425 Grand Boulevard, Montreal 28, P.Q.

For further information mark No. 17 on our Readers' Service Card

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THE QUALITY LINE OF INDUSTRY-PREFERRED
COMPONENTS

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VARIABLE TRANSFORMERS

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Ohmite now offers six basic models with current ratings sufficient to meet most industrial applications. All VT units give a sizeable "bonus" in current when the over-voltage feature is not required (see "N" suffix below). Variable Transformers are also available in enclosures, tandem assemblies, and with many special features.

BASIC MODELS (without overvoltage)

MODELS	All inputs 120 vac*
VT2N	— Volts output: 0-120 Amps output: 1.8
VT4N	— Volts output: 0-120 Amps output: 4.75
VT8N	— Volts output: 0-120 Amps output: 10.0

*Units available for 240-volt input also.

Write for Bulletin 151

OHMITE Manufacturing Co.

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RESISTORS RELAYS TAP SWITCHES
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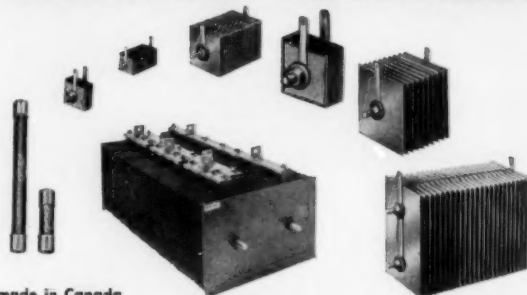
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provide greater d-c output per
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SYNTRON'S unique vapor deposit process and rigid quality control yield more efficient Selenium Rectifier cells. Cells noted for their low forward voltage drop, high reverse voltage, long life, uniformity, high temperature and voltage ratings—Cell voltage ratings from 15 to 52 volts RMS are available. Offering the widest range of cell sizes in the industry — from .280 inch diameter to 12 x 16 inch—permitting single stack assemblies from a few watts to many kilowatts. SYNTRON Selenium Rectifiers offer — versatility, dependability, long life, performance stability for all your d-c power applications.

Write for complete information and specification
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With experience as salesmen, branch managers or a background of technical or retail experience are invited to answer this advertisement. If you are active and in good health we have openings in exclusive territories for full time field or telephone subscription representation. Net earnings of our men average \$95.00 to \$125.00 weekly. Successful applicants will have choice of franchise for retail, industrial or transportation field, or a combination of these fields, on our business publications. Scores of old customers in each territory as a result of our 70 years in business. Our full franchise covers 40 publications. Pension, group life, hospitalization benefits. If satisfactory your application will be followed by personal interview in or near your home. Write John Foy, Circulation Manager, Business Publications Division, Maclean-Hunter Publishing Company Limited, 481 University Avenue, Toronto 2.

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NOW... a Complete Range of ARROW-HART Switch Controls



... One hole, quick make, quick break switches for radio and electronic equipment and all your small motor control requirements. Send for your copy of the new, illustrated Bulletin Z-2 today.



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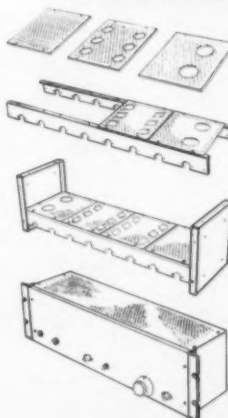
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5701

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LEKTROKIT

THE VERSATILE CHASSIS CONSTRUCTION SYSTEM . . .



HOW IT WORKS:

Perforated aluminum plates which provide maximum flexibility in positioning components comprise the basis for constructing chassis.

Four plates can be mounted on the two chassis rails to accommodate as many as 24 tubes plus other components. Rails are punched to accept switches, pots, etc.

Addition of two end plates attractively finished in grey enamel completes the basic unit and gives the impression of completeness to the most casual mock-up.

Finally, the addition of front panel and covers, also in grey enamel finish, makes a handsome enclosure for permanent circuits. Brackets are included for mounting unit in standard 19 inch rack.

LEKTROKIT consists of a few simple and inexpensive parts, from which electronic chassis can be constructed quickly. Keeps work in the Lab under designer's control. LEKTROKIT not only saves time and cost on experimental models but is suitable for more sophisticated construction as well as unlimited expansion in all directions.

PAYETTE RADIO LIMITED

730 St. James West, MONTREAL, QUE., UN. 6-6681

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CAS urges Canadian support for a Commonwealth space program

Canada should participate in a Commonwealth space research program. Speaking at the annual dinner of the Canadian Astronautical Society Dr. P. A. Lapp urged active participation and said that "this is both practical and desirable."

As president of CAS Dr. Lapp was speaking on behalf of the entire society.



Since its inception in 1957, CAS has grown to its present strength of 235 members. They have published nearly 2,000 technical reports and have established excellent relations with other Canadian societies.

In addition to this, a society delegate attended the World Congress of Astronautics at Amsterdam last summer. It was at this meeting that delegates from the Commonwealth countries first proposed working together on a space research program.

Society discusses data processing

The recently formed Computing and Data Processing Society of Canada has announced plans for a general meeting in June, and a drive for membership. The actual date for the annual general meeting is expected to be announced in the near future. In the meantime, the Society is engaging in a program to recruit new members. Anyone interested may obtain full details from Dr. C. C. Gottlieb, University of Toronto, Toronto, Ontario, or from any other director of the society.

Two meetings have been arranged for people interested in computing and data processing. The first meeting was held Feb. 3 at the University of Toronto. Dr. H. S. Gellman talked on

"An examination of trends in computing and data processing."

On March 26, Mr. L. J. Lacey will speak on "The use of a computer in stores accounting." This meeting will be held at 7.00 p.m. in the Bell Telephone auditorium, Beaver Hall Hill, Montreal.

Initial steps have been taken by the directors of the Society to become a charter member in the formation of an International Federation of Computer Societies. The final formation and inauguration of the Federation is expected to take place at the International Conference for Information Processing to be held in Paris, France, in June, 1959.

Engineers honor science teacher

The Association of Professional Engineers of Ontario has established an award for Ontario's "maths and science teacher of the year." This annual award will recognize the contribution made to the engineering profession by secondary school teachers in these subjects. All secondary school maths and science teachers in Ontario are eligible for nomination and final selection is made by the Ontario Secondary School Teachers Federation.



GILBERT A. MILNE

The award this year was won by H. E. Totton, head of the mathematics department at Toronto's Forest Hill Collegiate.

In the words of his sponsoring committee: "Mr. Totton has consistently fostered in his pupils an appreciation of the values of higher education and has, in this way, given to mathematics a vitality based both on its intrinsic values and its values as a partner with the other sciences."

COMING EVENTS

February

- 12-13 Solid-State Circuits Conference, Philadelphia, Pa.
- 20-24 Second International Exhibition of Electronic Components. Paris, France.

March

- 2-6 Western Joint Computer Conference. San Francisco, Calif.
- 23-26 Radio Engineering Show and IRE National Convention. New York.

April

- 5-10 Fifth Nuclear Congress. Cleveland, Ohio.
- 6-9 British Radio and Electronic Component Show, Grosvenor House and Park Lane House, London, W.1.
- 16-18 Southwestern IRE Regional Conference & Electronics Show, Dallas, Tex.
- 16-30 Engineering, Marine, Welding & Nuclear Energy Exhibition, Olympia, London.

May

- 4-6 National Aeronautical and Navigational Electronics Conference. Dayton, Ohio.
- 4-8 National Industrial Production Show of Canada, Exhibition Park, Toronto.
- 6-8 1959 Electronic Components Conference. Philadelphia, Pa.
- 25-29 International Convention on Transistors. Savoy Place, London, W.C.2.

June

- 13-22 International Conference on Information Processing. Palais d'Exhibition, Paris, France.

New products review

The first annual new products review will be published in the March issue. It will be a review of a broad selection of materials, components, instruments and electronic equipment that have been introduced to the Canadian market in recent months.

D. S. Simkins of Rogers Electronic Tubes and Components examines the causes of tube failures and makes comprehensive recommendations on tube selection and application to equipment designers and end-users.

Some considerations in designing and selecting semiconductor rectifiers are given in the feature article by A. M. Hase of Canadian Line Materials.

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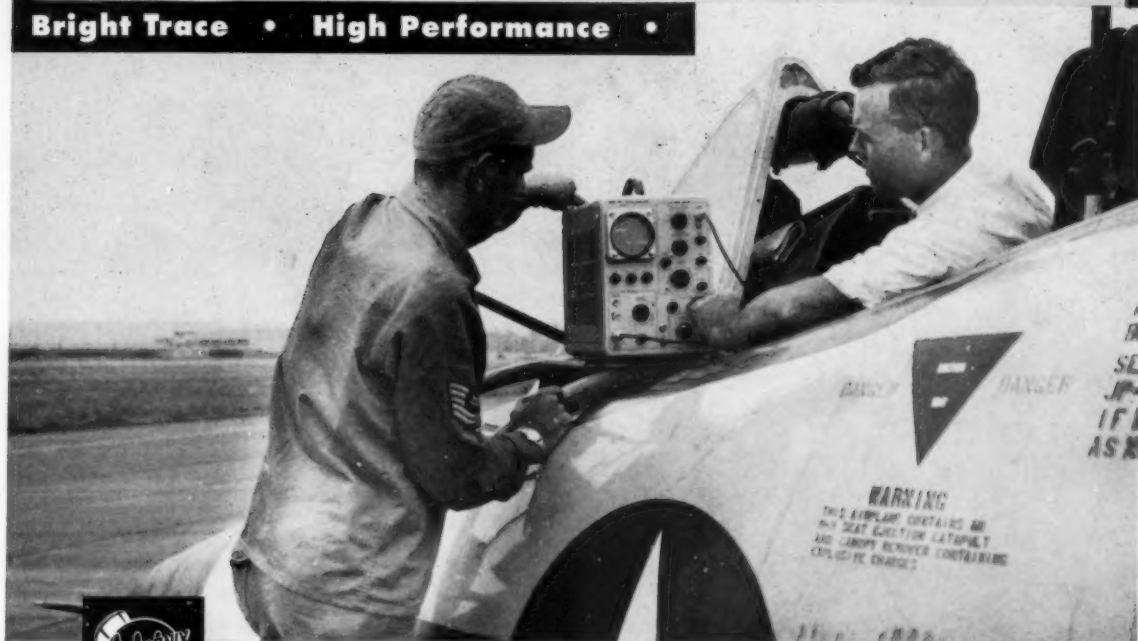
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NEW DAYLIGHT PORTABLE OSCILLOSCOPE

Bright Trace • High Performance •



Courtesy Commander 337th Fighter Group, U. S. A. F.



TYPE 317

It's excellent for the daylight conditions often encountered in the field and at production test stations. The brilliant trace, provided by 9-KV accelerating potential on a new Tektronix 3-inch cathode-ray tube, is easily readable in bright areas, even at low sweep-repetition rates. And its DC-to-10 MC vertical response easily takes care of most of today's complex field applications.

The Type 317 is an excellent laboratory oscilloscope, too. Ask your Tektronix Field Engineer or Representative to arrange a demonstration in your most demanding applications.

TYPE 317 CHARACTERISTICS

VERTICAL RESPONSE

Passband—dc to 10 mc.
Risettime—0.035 μ sec.
Sensitivity—0.1 v/div to 125 v/div, dc-coupled and ac-coupled—
0.01 v/div to 0.1 v/div, ac-coupled only. Twelve calibrated sensitivity steps.

SWEEP RANGE

0.2 μ sec/div to 6 sec/div. 22 calibrated steps from 0.2 μ sec/div to 2 sec/div.
5-x magnifier increases calibrated sweep rate to 0.04 μ sec/div.

TRIGGERING

Preset or manual stability control with amplitude-level selection, and fully-automatic triggering.

ACCELERATING POTENTIAL

9-KV on new Tektronix high-voltage 3-inch cathode-ray tube.

CALIBRATOR

Amplitude calibrator, 0.05 to 100 v in 11 steps, square-wave frequency about 1 kc.

OTHER FEATURES

Electronic power-supply regulation.
External input to horizontal amplifier.
Warning lights for uncalibrated sweep-rate and sensitivity settings.
Magnifier indicator light.
Size—8½" wide, 12" high, 19½" deep.
Weight—35 lbs.

Type 317 \$800 (50 to 60 cycle supply).
Type 317 MOD101 \$835 (50 to 800 cycle supply).
RACK MOUNTING MODEL—Same electrical specifications as Type 317. Dimensions: 7" high, 19" wide, 17 9/16" rack depth.
Type RM17 \$870
f.o.b. factory

Tektronix, Inc.

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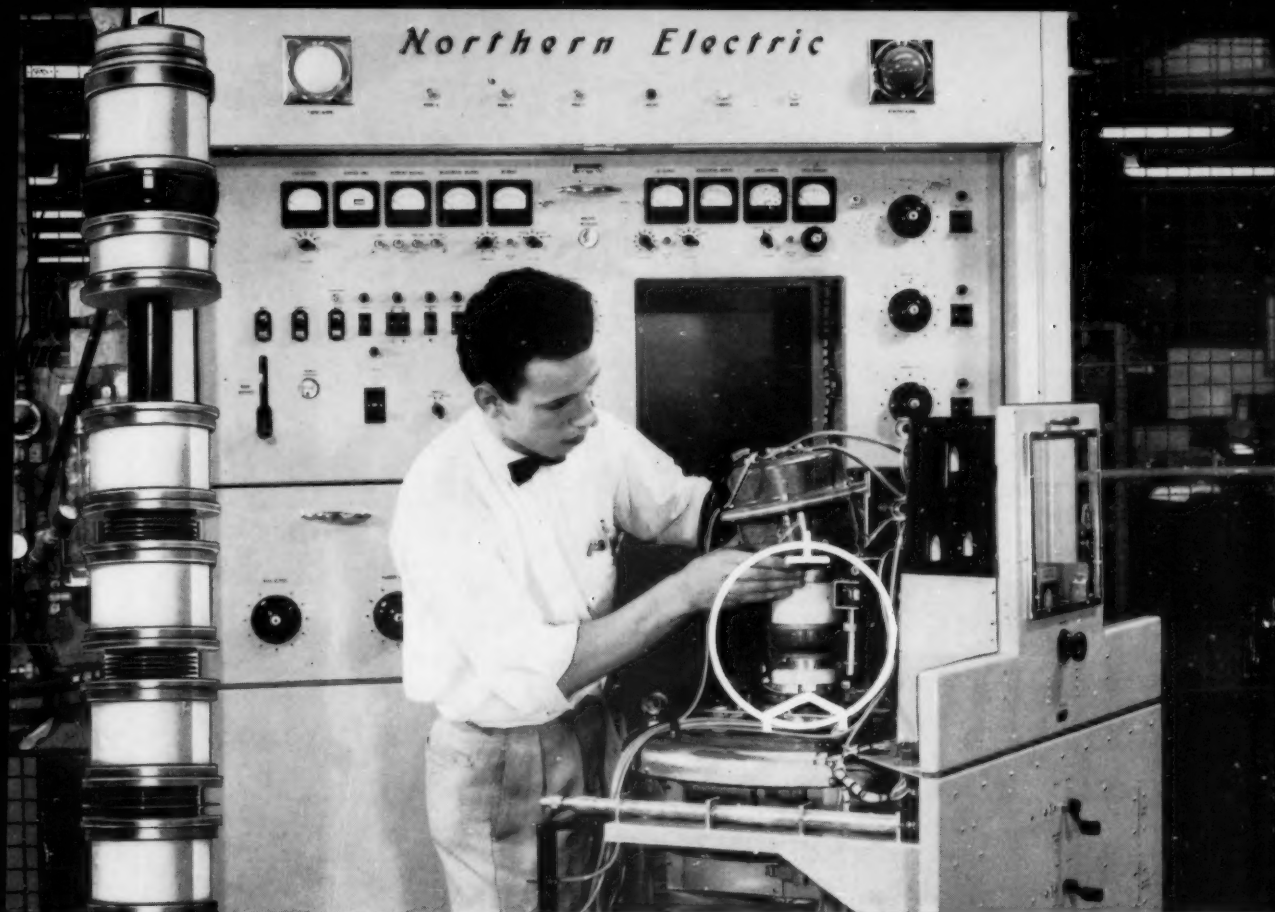
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Tektronix is represented in 20 overseas countries by qualified engineering organizations.

ENGINEERS — interested in furthering the advancement of the oscilloscope? We have openings for men with creative design ability. Please write Richard Ropiequet, Vice President, Engineering.

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Northern Electric



A Technical Assistant in Northern Electric's Product Engineering Department, installs the air system socket on an Eimac 4KM3000LQ klystron in one of the new Northern Electric "TELORIZON" transmitters.

LINKING LABRADOR WITH THE WORLD

The 2 kilowatt tropo-scatter transmitter shown here is part of the new microwave and tropospheric scatter system linking Goose Bay, Labrador with Quebec City. One of several 2 and 10 kilowatt transmitters built by Northern Electric for the Bell Telephone Company of Canada, it is equipped with an Eimac high power amplifier klystron that provides bandwidth and linearity for 200 voice channels—with telephone toll quality. The klystron, an Eimac 4KM3000LQ, is of a special four cavity type not previously used. It operates in the frequency range of 720 to 985

megacycles, with an efficiency of 42% and a 7MC. bandwidth.

The 4KM3000LQ features the unique Eimac depressed collector providing high efficiency at wide bandwidths. The Klystrons used with the system's 10 kilowatt transmitters are Eimac type 4K50000LQ.

The design, quality and performance of Eimac tubes have made them first choice with manufacturers across Canada—in a variety of fields, and for many different applications.

When you want quality tubes—of transmitting types—it will pay you to investigate Eimac first.

Eimac 4KM3000LQ, modulating anode, depressed collector, 2KW klystron.



Eimac First for high power amplifier klystrons.

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA



2036 Prince Charles Road, Ottawa

GENERAL CHARACTERISTICS

EIMAC 4KM3000LQ AND 4K50,000LQ KLYSTRONS
FREQUENCY RANGE
POWER OUTPUT
BEAM VOLTAGE
COLLECTOR DISSIPATION
COOLING

4KM3000LQ
720-985 MC
2 KW
10 KV
3 KW
AIR

4K50,000LQ
720-985 MC
10 KW
17 KV
50 KW
LIQUID AND AIR

